SCIENTIFIC AMERICAN

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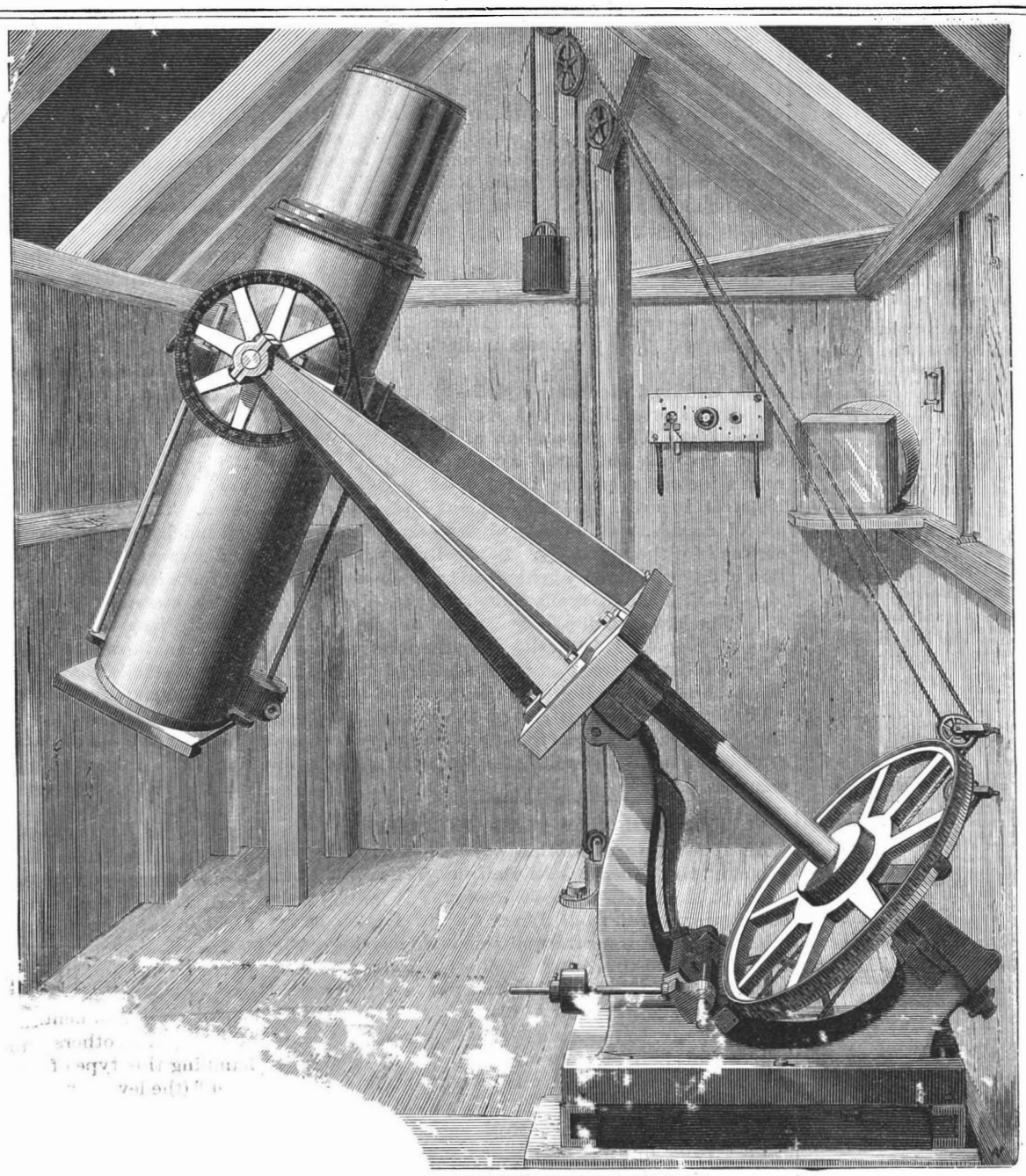
HARVARD OBSERVATORY AND THE HENRY DRAPER MEMORIAL.

In 1872, Professor Henry Draper first succeeded in photographing the lines of the stellar spectrum. Having secured this triumph for America, he pursued his researches in the same direction until his death in 1882. His skill and ingenuity were alike remarkable. He was not one of those observers who, leaving details to others, try merely to do the final operations. He possessed the quality of thoroughness, and personally attended even to the mechanical details of his investigations. He ground his own specula. It is not too much to say that the work done by him derives a character of value and reliability from the attention to detail that only such an investigator could give it. His powers of handiwork, combined with his scientific standing, make him a model for astronomers. Had dry plate photography been at his service, his work would have taken a far wider range. But using wet plates, that can only bear comparatively short exposures, he was [illegible] mense dis[illegible] interestin[illegible] labors [illegible] fellowship [illegible] is said that [illegible] to his obser[illegible] her. Hence peculiar grace Draper became t[illegible]



H PHOTOGRAPHIC TELESCOPE.

er of the Henry Draper memorial. From funds of her providing, the expense of continuing Dr. Draper's sadly interrupted labors is sustained. No more fitting and useful memorial of the great scientist than this can be thought of. Besides this, Mrs. Draper continues to take a personal interest in the work as done. Apparatus formerly belonging to and constructed by Dr. Draper is soon to be added to the working appliances of the observatory by her liberality. Photographs of the spectra are sent her, and she maintains a vivid interest, because an intelligent one, in the results.

The different buildings containing the instruments and laboratories of the Harvard College observatory are situated in Cambridge, at quite a distance from the college whose name they bear. They are scattered over the crown of a grassy hill. On entering the grounds, the first building seen is the residence of the director, Prof. Edward C. Pickering. Directly in the rear of this is the old Harvard College observatory, with its equatorial and its 15 in. telescope, a German instrument, in its day one of the great telescopes of the country, now relegated to the background by the triumphs of Alvan Clark and his sons. Back and to the side of these are what now

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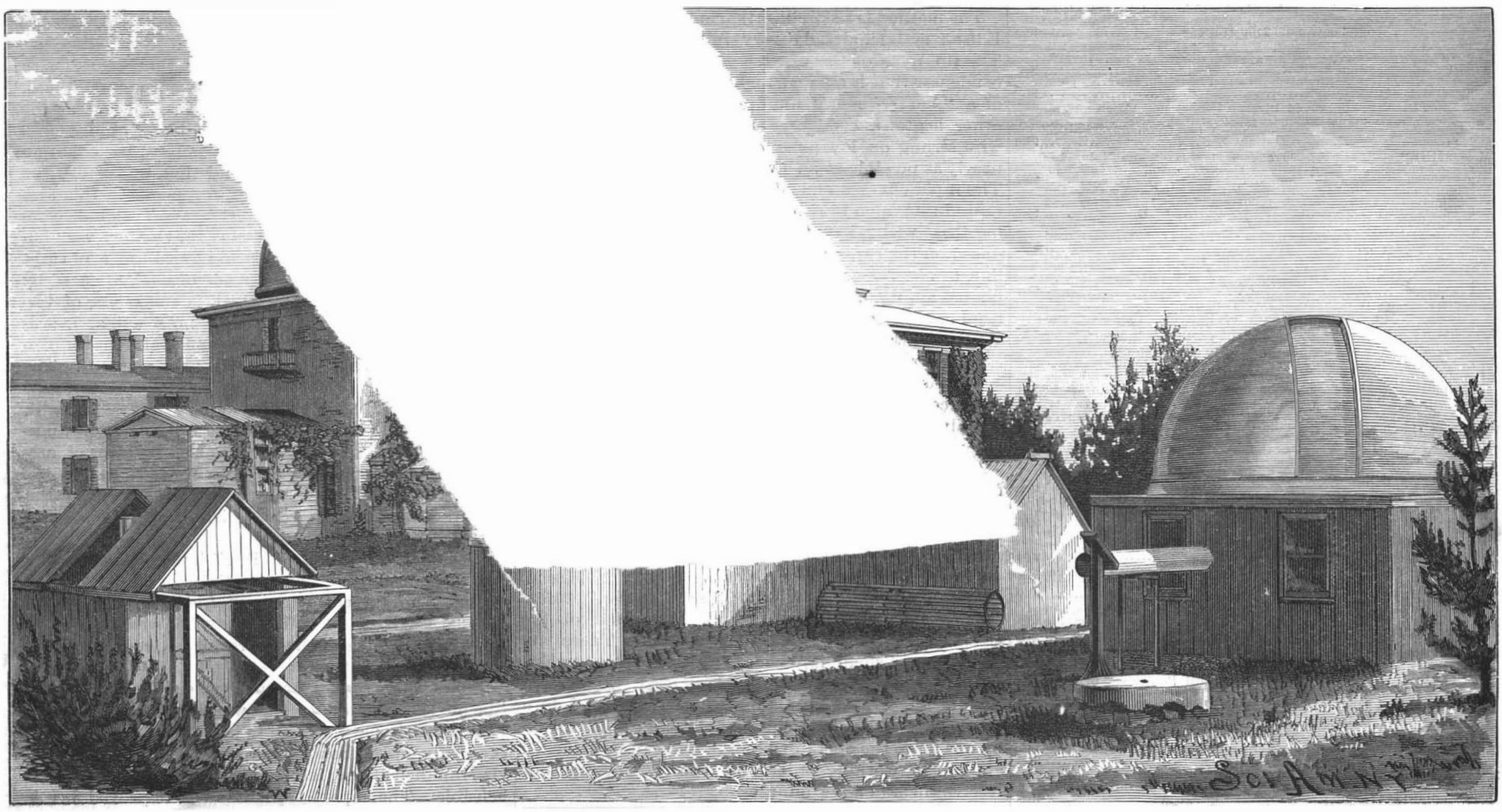

GENERAL VIEW OF THE HARVARD OBSERVATORY.

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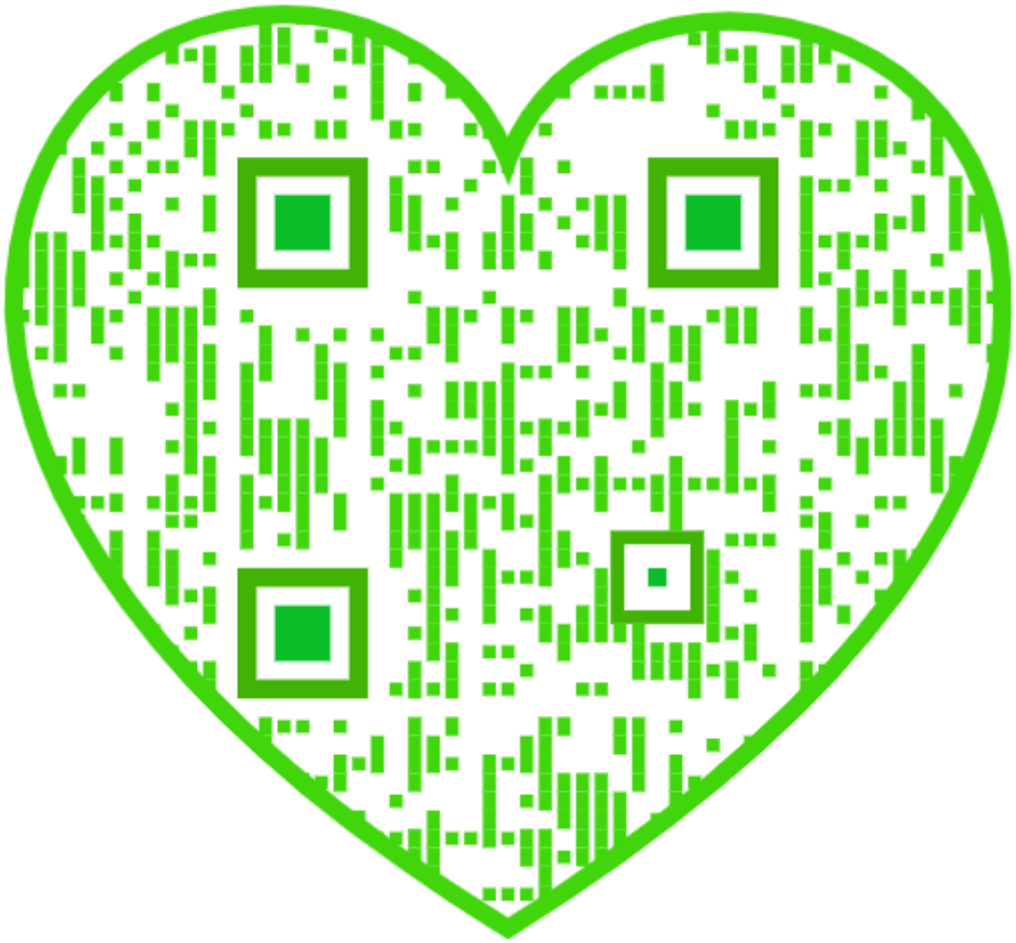

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NEW YORK, SATURDAY, OCTOBER 15, 1887.

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RAILROAD MEN'S BUILDING.

The new Railroad Men's Building, erected in this city by Mr. Cornelius Vanderbilt, at a cost of $100,000, as a gift to railroad employes, was formally opened on October 3, 1887, when it was turned over to the uses of the Railroad Branch of the Young Men's Christian Association. Speeches were made by the donor, Mr. Vanderbilt, and by several others. Then they were responded to in an address of acceptance by Mr. Elbert B. Monroe in behalf of the association to whom the building is specially dedicated. Bishop Potter was present, and created somewhat of a sensation by proposing three cheers for Mr. Vanderbilt. Mr. Chauncey Depew closed the proceedings by one of his characteristic addresses.

The building is situated on Madison Avenue near the Grand Central Depot. Within it contains all the appurtenances of a well-ordered club house—lecture room, bath rooms, reading room, lunch room, etc. Entertainments by prominent lecturers are to be given there throughout the season, and there is little doubt that much pleasure and profit will be derived by the railroad employes from this gift of the railroad magnate.

The building is to be accessible to all employes of roads using the Grand Central Depot. It is not exclusively in the possession of the Young Men's Christian Association. This point was made by Mr. Vanderbilt in his speech.

The building, of ornate style in brick and terra cotta, is two stories high. The roof is of glazed Spanish Akron tiles. The gymnasium and bowling alley are fitted up with the latest improvements. The bath rooms include a plunge bath, 6 feet deep and 9½ by 13½ feet in area. In the basement all the partitions are of marble, with bronze framework. Brass pipes are used for the plumbing. In the library is a collection of 6,400 volumes of general and miscellaneous reading. In the reading room 100 newspapers are kept on file. The lecture hall is 36 by 66 feet in area, and can seat 400 people. It is finished in oak, cherry, and ash. The building is wired and piped for electricity and gas. The architects were Robertson & Potter, of this city.

For a nominal charge any of the railroad employes on the specified lines has full use of the privileges, and after being in good standing for a year becomes a life member.

EXHIBITION OF TRAIN TELEGRAPHY.

An interesting exhibition of train telegraphy was given by the Consolidated Railway Telegraph Company, of this city on the 6th instant. A special train of six cars was run from Jersey City to Easton, carrying the apparatus for transmitting and receiving. The train contained the guests of the Consolidated Company, and the party was the outcome of an invitation extended by Mr. Charles A. Cheever, the president of the company, to the New York Electric Club. The trip occupied about five hours. During the running of the train, the operator was kept busy sending an[d re]ceiving messages. Although the speed of th[e] no relation to the practical working of [the] yet a greater measure of public appr[e]ciation looked for from the fact that the cars [ran] speed, exceeding sometimes sixty mil[es]

The method is a simplification in [the] Edison system, already very ful[ly] The tin roofs of the cars are u[sed] condenser that is charged and [discharged] of a "buzzer" many hundr[ed] other leaf of a condenser is [formed] wire strung on low poles [parallel] nearly as possible at an ev[en] The rapid charges and d[is]charges reproduced upon the lin[e] ing these with a key, [or] duced on the car, ar[e] line, or *vice versa*. phones are used. head against t[he] He then est[ablishes] car seats, [and] The eas[e] is notic[eable] rapidl[y] any [other]

f

are thus connected to[gether] car connections are the acme of simplicity.

The apparatus consists of the "buzzer," transmitting key, and induction coil. The core of the latter is the magnet of the "buzzer." These are secured to a small lap board. For battery, twelve chromic acid cells (Bunsen type) are used. A compact form of these has been adopted, and is carried in a hand case. The whole equipment for a car is carried by one man, the operator himself, and can be attached and put in working order and transmit messages or receive them in a few minutes.

The great advance over the old Edison method consists in the use of a single line wire instead of a number of parallel lines. The reduction of the quantity of apparatus and its portability are also notable.

Many well-known scientists and electricians were on the train; among others, Thos. A. Edison, Prof. Barker, Messrs. Pope, Gillilland, Phelps, Van der Weyde, and others. The opportunity was taken for sending and receiving many congratulatory messages.

MAGAZINE RIFLES.

The merits and defects of the various types of magazine guns are just now attracting much attention in the European military press. *L'Avenir Militaire* makes serious charges against the efficiency of the German magazine gun, with which the German infantry have been supplied, and the *Militar Wochenblatt* replies with similar charges against the French arm. The one charge and the other do not differ essentially; neither the German soldier, with the new "Mauser," nor the Frenchman with the "Lebel," have yet got the "hang" of the magazine rifle, which, being far more complicated than the old arm, requires more careful handling. That novices at such mechanisms should be awkward is scarcely surprising, and the observer at the butts, however friendly, would see little to praise in their target practice. That skill as well as experience is required to get the real value of the magazine gun has been clearly demonstrated during the last few months; and an excellent proof that the new arm is not altogether satisfactory is to be found in the German and French military journals, which, while indignantly denying the truth of the assertions made by hostile critics, seem unable to bring forward any facts or figures to aid them. Thus the *Deutsche Heeres Zeitung*, just at present much wrought up over the published observations of a correspondent of the Swiss journal *Gazette Suisse*, contents itself with denying in general terms the truth of his statements, and makes no attempt to go specifically into the charges. It says that the new arm has been shown, beyond peradventure, to be at least quite as efficient as any other type known; that it is simple in construction, strong in parts, accurate in fire, and in the hands of the German soldier, accustomed to handling the old *Zundnadelgewehr*, of which this is only an improvement, is more effective than any other. Yet the Swiss correspondent, who witnessed the work of a part of the 25th corps at the butts, only corroborates other military observers when he declares that men draughted from the farming districts of Bavaria, Wurtemburg, and especially the Pomeranians, Westphalians, and West Prussians, cannot, because of the great size of their fingers, operate the mechanism of the Mauser magazine gun with nicety, dispatch, or safety to the parts; and that in such unskillful hands the advantages of a quick-fir[ing] thro[w] ost and its defects made more prominent. [The] cartridge

Again, like others [have] and t[he] d raw levies handling this type of [rifle] a "extractor r" (the lev[er] y shell and worked by t their fin[gers]. The con[struction] y of the piece, end as the car[tridge] ncertain, because

, the "Lebel," with been armed, it has, same defects as the r being quicker and chanism, the equation g is less, as are also the mprovements in this arm l General Tramind, com[mandant] hool of St. Cyr, are very im[portant] he arm now in use, is of eight lets, made of steel, are fired by der, which is smokeless, of tre[mendous] gives little or no recoil, and, it is he discharge is so slight that it can[not] a distance of twenty-five yards. The uch smaller than that now in use, as is idge, yet the trajectory is almost straight, eing hit at long range 95 times out of a pos[sible] by those at all accustomed to arms of any n some respects this new piece resembles the ly invented Pralon rifle, but in its mechanism eradicated the defects which that was seen to ssess.

Recent experiences of the English with the repeating rifle have been peculiarly unsatisfactory. The *Broad Arrow*, quoting the *Times of India*, says that the exhaustive trials at Bengal have proved that both the Lee-Burton and the improved Lee are altogether unsatisfactory. It says:

"That there should be many who object to the new rifle on the grounds of the waste of ammunition involved is only natural, and to be expected, but to find the weapon itself breaking down in its strongest point, viz, rapidity of fire, is astonishing, but not incomprehensible. The report says that the improved Lee is the better of the two, but that when any large number

* See SCIENTIFIC AMERICAN, Vol. 54, No. 8.

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of rounds have to be fired, the Martini-Henry is quicker than either. The term 'repeating rifle' is really misleading to the non-military public, and the name 'magazine rifle' is far more accurate. Many people seem to imagine that the repeating rifles fire continuously like a revolver, up to a certain number of shots, by merely pulling the trigger; but this is far from being the case. Each cartridge has to be extracted, and the breech closed as in the case of a single loader, the only time saved being that employed in taking a fresh cartridge out of the pouch and placing it in the chamber, while, when the magazine is emptied, it is necessary to refill it, cartridge by cartridge, thus wasting as much time as is occupied in loading the same number of cartridges direct into the chamber. The addition of a fixed magazine must of necessity make the rifle clumsy and awkward to handle, while it must either make the balance unequal or depend solely on a spring for its action."

How French Bread is Made.

One summer's day we stopped to call at the stone farm house of Monsieur Duval. Ernestine, the eldest daughter, was housekeeper in her dead mother's place, and she it was who brought out the amber-colored cider, the goat's cheese, and the heavy, hard, country bread. It is an essential of French peasant hospitality to offer these things to visitors.

The loaf she took from the shelf was one of half a dozen leaning against the black wall. These loaves resembled cart wheels, and had been baked in six-quart milk pans. Ernestine cut the loaf with a small saw made for the purpose! Nothing less than such a saw, or a pirate's cutlass, could sever that homely but wholesome *pain rassis*.

These loaves, we knew, were baked only once a month. Bread day in a Norman peasant family is like washing day on an American farm, in the respect that it comes at regular periods. We judged that bread day in this cottage was approaching, from the fact that only six loaves remained of the original thirty or thereabout.

After our luncheon Ernestine took us through the orchard to a picturesque stone building, where the bread was wont to be made. This building had once been part of an ancient abbey, and amid its ivy-covered ruins we could still trace fine sculpture and bits of armorial designs, but inside there was no trace of art or architecture. It was really a Norman hen house. We saw several pairs of *sabots* or wooden shoes hanging from the wall and looking as if they had been whitewashed.

In one corner of the place was a large space inclosed with boards. This was empty, but, like the *sabots*, it suggested whitewash or mortar making.

Ernestine told us that this was the family dough trough. Hither, once a month, came her father and the hired man to "set" the yeast a-rising. Flour and water were stirred together with the huge wooden spades shaped like our snow shovels which hung with the *sabots* upon the wall. When the mass, thoroughly beaten together, had risen and assumed a dark color and leathery consistency, then came the tug of war. The two men put on the *sabots* over their ordinary shoes, jumped in upon the dough, and began the kneading. Their way was to hop and prance and flourish like opera dancers, to stamp and kick like horses, exerting themselves till the perspiration streamed off them and they had no strength left. After this process the dough was put into the pans, and then baked in the huge oven at the rear of the abbatial hen house.

In all Norman towns half-clad men may often be seen lounging about bake house doors. Their legs and feet are bare and floury, and as they tread the streets we know that they have just come from or are returning to their usual occupation of kneading bread.

"*Mon Dieu!*" exclaimed Ernestine when we told her that in America bread making was woman's work. "*Mon Dieu!* how cruel your men are! I would rather shoe horses!"—*Epoch.*

Great Pumps.

The Lawrence Machine Company, Lawrence, Mass., have been awarded the contract for one of the largest pumping plants ever planned in America. The plant is for the city of Montreal, and consists of four centrifugal pumps, each with a discharging opening of 24 inches diameter, and capable of handling 18,000 gallons of water per minute, and four similar pumps of 15 inches discharge opening, and a capacity of 7,000 gallons per minute. Thus the four 24 inch pumps have a combined capacity of 72,000 gallons per minute, 4,320,000 gallons per hour, 103,680,000 gallons, or 386,000 tons, of water per day of twenty-four hours; and the four 15 inch have a combined capacity of 28,000 gallons per minute, or 1,680,000 gallons per hour. These pumps are contracted for by the Inundation Committee of Montreal, and are designed to pump the sewage of the city over the walls and dikes now in process of erection to protect the lower portions of the city from the annual inundation caused by the floods and ice gorges of the St. Lawrence River.

PHOTOGRAPHIC NOTES.

Instantaneous Photographs Made at Night.—With rapid plates of the present time, no trouble is found in taking instantaneous photographs by day light, but doing such work at night is something quite new. Messrs. Goedicke and Miethe, of Germany, recently succeeded in producing a flash of light of surpassing brilliancy and actinic force, by mixing an explosive compound of magnesium powder, chloride of potash, and sulphide of antimony.

Experiments show this compound to be rather dangerous, requiring especial care in its handling.

Quite recently, Dr. H. G. Piffard, of this city, a member of the Society of Amateur Photographers, carried on a series of experiments with a view of overcoming the dangerous qualities of the potash and magnesium compounds, and finally ascertained that a similar light of great power could be easily made by mixing with seven grains of gun cotton from fourteen to twenty grains of magnesium powder. There is no danger connected with this light. The gun cotton flashes instantly, as soon as ignited, and combines with the magnesium to produce an intense actinic light. The lens is used with full aperture, while the light is placed about ten feet from the object.

We were shown a negative made with this light which was quite remarkable for the density of the image and the detail exhibited in the dark portions of the object. Of course a plate of high sensitiveness had to be employed.

One of the Causes of the Fading of Photographs.—The *Photographic News* finds that salts of iron in cardboard mounts have a deleterious effect on the photograph It says: Iron, in one form or another, is present in every sample of dark-colored or buff card which we have examined, and it is with respect to the darker colored cards that we have received the bulk of complaints. In the case of some of these mounts, the iron is so loosely held that water alone will extract enough to strike a blue color with ferrocyanide of potassium; but in other instances the iron is not extractable by water alone, but readily comes into solution if a portion of the mount is treated with water containing a little hydrochloric acid.

The body of the buff-colored mount is generally made, for the sake of cheapness, of a pulp containing iron, this metal usually being in an insoluble state in the case of the individual sheets of which the card is built up; but in the process of mounting these sheets, the elements necessary to produce soluble iron compounds are introduced, as the paste or cement used almost invariably contains an appreciable portion of common salt (chloride of sodium), and, if not acid when used, generally becomes so before the sheets of cardboard are dry.

In such a case, the soluble and highly mischievous perchloride of iron is formed, and either makes the prints fade all over or works through holes in the enamel coating, and produces the spotted appearance so familiar to professional photographers. If the starch, paste, and gum for mounting the photograph become sour, the iron will be transformed into a harmful salt.

Testing for Iron.—A mount may be tested for iron in the soluble state by first making an infusion, that is, cutting up portions of the mount and soaking in warm water. If a few drops of a cyanide of potassium solution be added, a blue color should at once appear, provided any iron is present. A soluble iron compound may be considered in all cases as injurious.

To test for iron in an insoluble state, but in such a condition as to readily become soluble, pour fresh water on other pieces of the same mount, and for each drachm of water add two drops of pure hydrochloric acid, allow the whole to soak for an hour or two, and then filter off and test with ferrocyanide of potassium, as before. Iron in the condition indicated by this test may become soluble and mischievous, if the photographs are allowed to remain in a damp place, as then the paste used in making the card will probably become acid.

Very Queer Law.

If a decision just made by the Supreme Court of Connecticut is sound law, real estate on the banks of rivers with a tendency to change the course of their channels is a dangerous investment for capital. The court holds that rivers are natural boundaries, and when they alter their course their functions as boundaries are not affected by their former relation to lands. That no mistake may be made interpreting the meaning of the court, the decision gives a forcible illustration of a possible result from the waywardness of the river. "If," the decision says, "after washing away the intervening lot, it should encroach upon the remoter lots, and should then begin to change its movement in the other direction, gradually restoring what it had taken from the intervening lot, the whole, by law of accretion, would belong to the remoter, but now approximate, lot." Under this statement of the law an owner on the river front is not only liable to see his property gradually disappear under his own eyes, but if it reappears subsequently it belongs, not to him, but to his fortunate next-door neighbor.

Oil from Grape Seeds.

In Italy oil is now made from grape seed. According to the *Revue Francaise*, the following is the method employed. On being removed from the wine press the marc is well dried, the seeds are separated by a fan, and afterward subjected to a cleaning process.

When perfectly clean and well dried, they are ground like wheat. The finer the flour thus obtained the greater the yield of oil. The milling requires some attention as regards the arrangement of the millstones. As soon as the first product is withdrawn, it is bolted; that which is left on the bolting cloth is again ground, and so on, care being taken to add a little water to the flour as it passes between the stones. The product from the mills is then thrown into boilers. If ten kilogrammes, for example, are to be treated, in the middle of the mass, and into a hole extending to the bottom of the vessel, three liters of water are poured. The vessel is then placed over a slow fire; the flour little by little is stirred with the hand or with a spatula, to mix it well and to prevent the formation of lumps, and it is left over the fire until the hand cannot bear the heat of the mixture. This operation is very important. The better regulated the cooking of the flour, the greater is the quantity of oil obtained. The flour, still hot, is placed in wrappers, and is taken to the press and treated like other oil-producing seeds. After the first pressure the mass is broken down by hand and pressed a second time. One hundred kilogrammes of well-ripened grapes give from ten to twelve kilogrammes of oil.

Sulphurous Fumigations.

The Havre Congress of Hygiene have agreed to publish a set of directions for disinfecting, for the benefit of doctors or masters of infected vessels. Brimstone, broken up in small pieces, should be placed in broad and shallow earthenware or cast iron dishes, of about 1 liter capacity. The vessels should be of one piece, without solder, and, as a precaution against fire, should be placed in tubs holding 2 or 3 in. of water. To light the brimstone, either sprinkle it with a little alcohol or tip it with a little cotton wadding dipped in the same liquid. For each cubic meter of room, 30 grammes of sulphur are requisite, or about 1 oz. for each 40 cubic feet, all the openings being kept tightly closed for twenty-four hours. How to proceed when a large space is to be disinfected, and how to open the doors after fumigating, are described in detail, but one of the characteristic cautions given by the wise men at Havre is to avoid as much as possible, on board steamers, to let sulphur fumes get into the engine room—not that serious harm is to be apprehended, but because the vapors turn polished brass and steel an ugly red color, which greatly displeases the engineers.

The British Standing Army.

The "General Annual Return of the British Army" for the year 1886 has just been presented to Parliament. On the 1st of December, 1886, the composition of the *personnel* of the army was as follow:

Officers	7,204	
Warrant officers	687	
Sergeants and farriers	12,756	N. C. O.'s and men 200,672.
Buglers, etc	3,376	
Rank and file	184,540	
Total	208,563	

The nationalities of the non-commissioned officers and men of the army were as follows:

English	146,171
Scotch	16,446
Irish	32,153
Various	3,437

Oxychloride of Zinc Cement.

This cement or mastic is prepared by mixing 1 part of the finest pulverized glass with 3 parts of oxide of zinc thoroughly calcined (made from the carbonate), which is afterward kept in well-stoppered glass vials. Separately 1 part of borax is dissolved in the smallest possible quantity of water, it is mixed with a solution of chloride of zinc of 1·5–1·6 sp. gr., and is kept in this state in well closed vials. To use this mastic, enough of the powder is mixed with some of the liquid to form a putty, which hardens readily until like stone. Under the name of Paris dental cement a similar preparation is sold in the pharmacies which has even been used for filling hollow teeth. This composition can serve excellently for many other purposes; for example, to attach to each other different parts of technical, scientific, or domestic appliances, where a tenacious, quickly hardening cement is required.—*L'Elettricita.*

AN ingenious plan to save a dying pear tree was adopted in the garden of L. M. Chase, of Boston. The mice had girdled the tree so that it seemed bound to die. Mr. Chase planted four small trees around it, and close to it, cut off the tops, pointed the ends, and, making incisions in the bark of the pear, bent the small trees, and grafted them upon the dying trunk. They all lived, and that tree draws its nourishment from the small ones. This season a bushel of handsome pears were taken from it.

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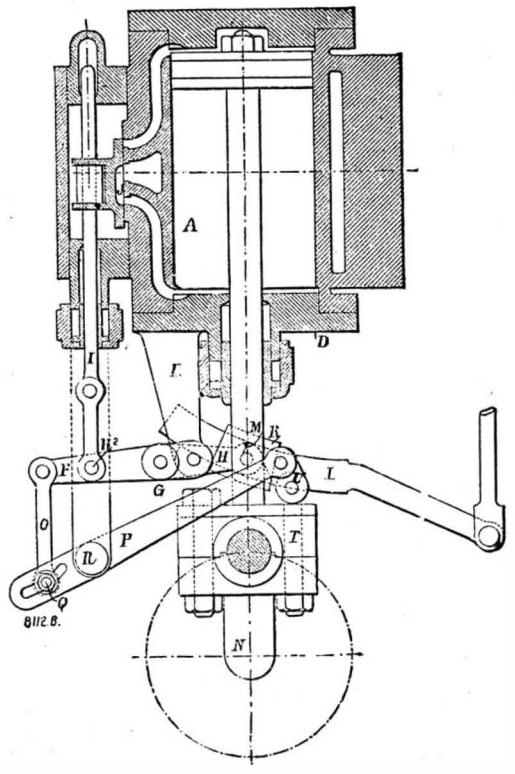
VALVE GEAR FOR OSCILLATING ENGINES.

We illustrate a novel and ingenious valve gear for oscillating engines devised by John William Hartley, of California Works, Stoke-on-Trent, England, and given in *Engineering*, from which we take the following:

This gear does away with the necessity for the use of eccentrics and permits of the expansion being varied at will up to the latest point of cut-off for which the engine is designed. We give two engravings, one showing the gear in perspective applied to an engine with the crankshaft above the cylinder, and the other illustrating an engine of the inverted type. The arrangements are practically identical, but some of the parts are more clearly shown in one view, and some in the other. The same letters of reference appear in both engravings. The cylinder, A, rocks on trunnions, B. On its upper cover it carries a bracket, E, which serves as a fulcrum for a lever, F. In this lever there is a boss, through which there passes a pin, G, forming a portion of a double-armed lever, H H, which at one end is connected to the valve spindle and at the other to a slipper block, K, sliding on a curved bar or link, L. This link is pivoted to the framing at its center by a stud, M, which is on a line drawn through the center of the crankshaft and the center of the trunnion. It can be moved and set to various positions about this stud by a reversing lever and quadrant, not shown in the engravings.

The curvature of the link is struck from the center of the trunnion, and when the link is in mid-position the slipper moves backward and forward on it without any vertical motion, and consequently there is no movement of the valve. If the link be tilted either way, the lever, F, is made to oscillate on its fulcrum, G, as the cylinder rocks, and the valve is moved to and fro, admitting steam to drive the engine backward or forward, according to the position of the link. The motion of the valve is reversed when the cylinder attains its maximum swing in either direction, and hence it follows that the mechanism we have already described, and which by itself is not novel, is not able to give either lap or lead. To enable the steam to be used expansively, a second motion is imparted to the valve from the piston rod. The outer end of the lever, F, is connected by a link, O, to a lever, P, carried by a bracket, R, attached to the cylinder. The further end of the lever, P, is coupled by a link, U, to the crosshead of the piston rod, and follows its motion. When the



piston descends, the lever, F, rises, carrying up with it the pin, G, and forcing the lever, H H, to oscillate about the center of the slipper, K, and to raise the valve. The levers, P, F, and H, are so proportioned as to give the slide valve an amount of travel at each stroke of the engine equal to the sum of the lap and lead, and this is a constant quantity independent of the position of the curved bar or link, L. By varying the position of the curved bar, the total travel of the valve can be changed as desired. The slot in the end of the lever, P, permits of the slack caused by the wear of pins being taken up.

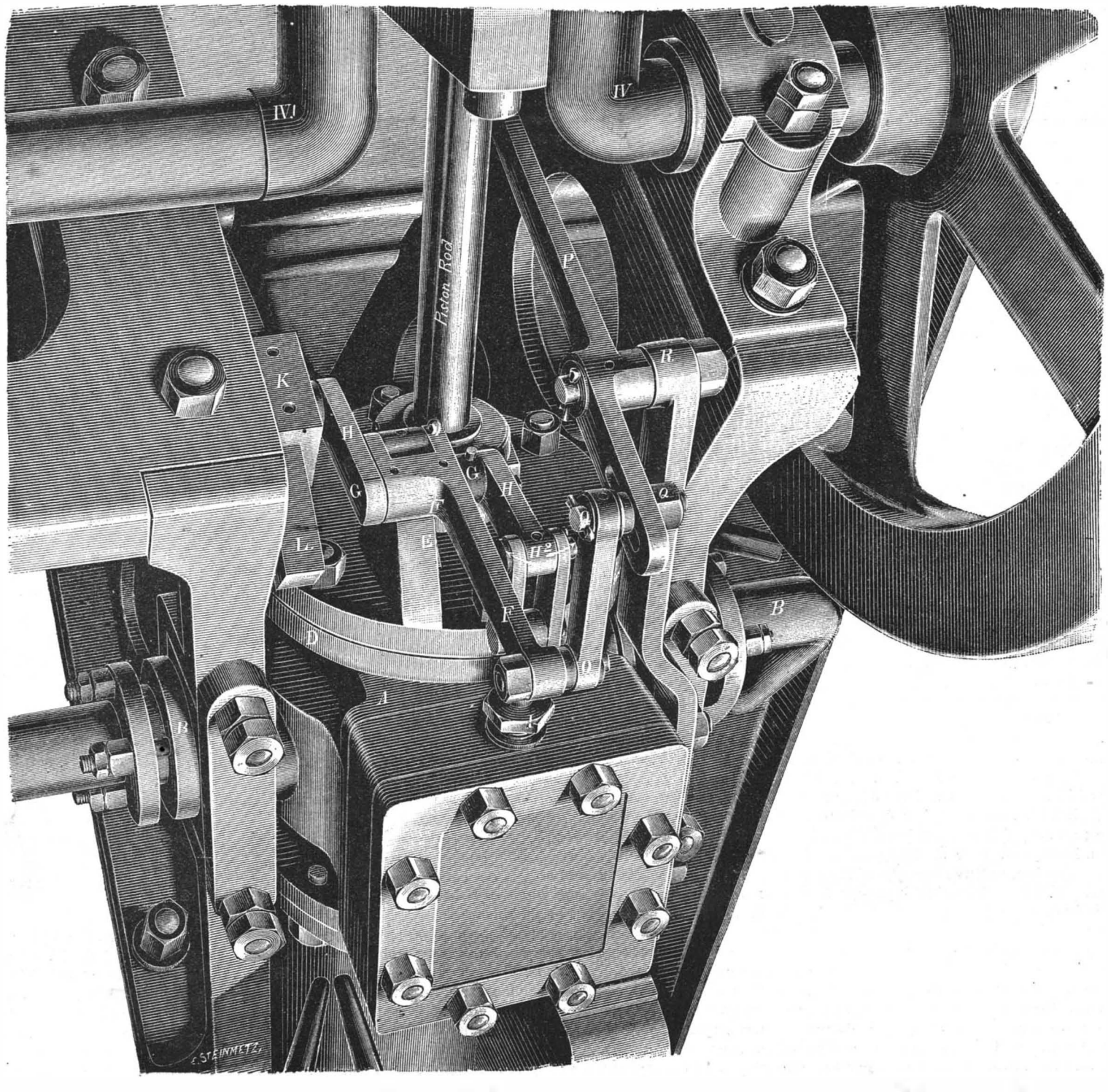
Driving a Spike under Water.

In mill work, especially when making repairs, it is often necessary to drive large spikes in water to the depth of two, three, and even four feet. Starting a spike by hand, and then attempting to drive it by means of a crowbar, is an unmechanical proceeding, to say the least. The *Manufacturers' Gazette* says one of the neatest and also the best ways of effecting the desired object is to get a piece of steam pipe of sufficient size to permit the spike to drop easily through it. Place one end of this pipe upon the spot where the spike is to be driven, drop the spike into the pipe, point first, and then follow it with an iron rod just large enough to slide easily in the pipe. By using the iron rod as a battering ram, or like a churn drill, the spike can be easily and quickly driven home without spattering the person with mud and water.

An improvement on this spike-driving rig may be made by getting a cast iron ball of two, four, or six pounds weight, drilling a hole through the ball sufficient to receive the iron rod, also drilling another hole to receive a set screw. By screwing the set screw down upon the rod, the ball can be held in any desired position. This ball gives extra weight to the driving rod, and, in fact, forms a kind of hammer whereby the spike can be more quickly driven home. It will not work well if you try to drive the spike by means of the rod and a sledge hammer. It is better, by all means, to rig up the ball above mentioned, which will do the work well and quickly.

Radiations from Melting Platinum and Silver.

M. J. Violle has studied these radiations by means of a thermopile, one surface of which received the radiations and the other was exposed to a known source of heat in such a manner as to bring the needle of the galvanometer to zero. It was found that the total radiation of melting platinum is fifty-four times that of melting silver.—*Comptes Rendus; Amer. Jour.*



IMPROVED VARIABLE EXPANSION GEAR.

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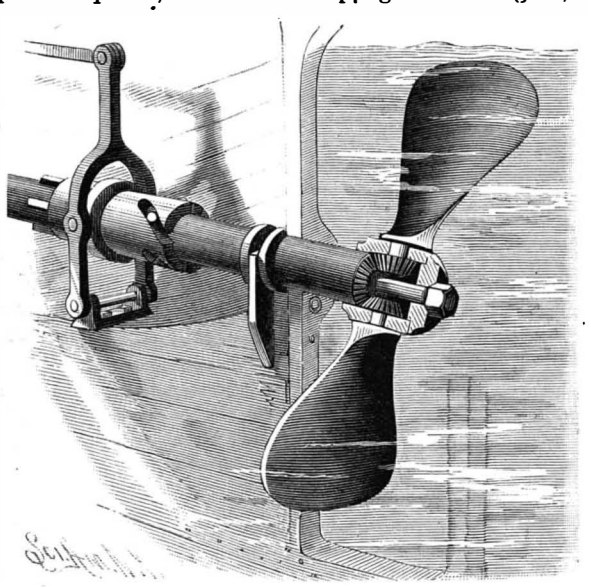
AN ADJUSTABLE PITCH SCREW PROPELLER.

An invention providing means whereby the blades of a propeller may be changed to any desired angle or pitch required, without the stoppage of the engine, is



STEVES AND HILL'S SCREW PROPELLER.

shown in the accompanying illustration, and has been patented by Messrs. William J. Steves and Andrew J. Hill, of Mechanicsville, N. Y. A sleeve, having on its rear end a beveled gear, is mounted on the propeller shaft, and the shank of each propeller blade, projecting down through the hub, is made with an integral bevel gear to mesh with that of the sleeve. The latter has collars where it passes into the hull, and on its interior end are four integral pins, which are received in the cam slots of a second or reversing sleeve, mounted upon the shaft and upon the inner end of the first sleeve. The inner end of the reversing sleeve has a wide interior collar with a series of longitudinal grooves engaging with corresponding feathers formed longitudinally on the shaft, there being also an exterior collar in alignment with the interior one, the exterior collar being engaged by an interiorly grooved ring having trunnions on opposite sides, journaled in the U-shaped arms of a lever, whose lower ends are fulcrumed upon a pillow block fixed to the bottom of the boat. To the upwardly extending arm of this lever is pivoted a rod adapted to extend back to the engine room or other convenient place, where it may be operated by hand or steam power. While the propellers are revolving, a movement of this lever and strap will also move the interior sleeve, and its cam slots, through the pins on the inner end of the other sleeve, will revolve the latter, with its bevel gear, to turn the flukes of the propeller to the desired angle or pitch.

AN IMPROVED HOUSEHOLD ASH SIFTER.

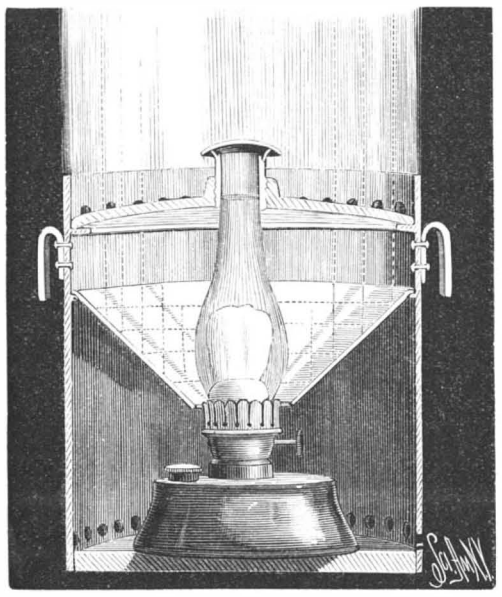
A convenient sifter and receptacle for ashes, whereby the partially burnt coals can be effectively separated from the ashes, and the work can be easily done at the

FALARDEAU'S COAL AND ASH SIFTER.

fireside without causing annoyance or inconvenience from the escape of dust, is shown in the accompanying illustration, and has been patented by Mr. Dennis L. Falardeau, of Cohoes, N. Y. The sifter is supported within a case or outer vessel, which has a pivotal bail to carry it by and a close-fitting cover. For a little more than half its depth the sifter is made closed or imperforate, the other part being made of fine wire cloth or netting, or of perforated metal plates if desired; but a considerable portion of this perforated part is made as a door, through which the coal and ashes to be sifted are passed, the door being hinged at one side and having a latch or lock button at the other edge. There is also a door, arranged to be buttoned or latched, in the lower portion of the sifter, through which the sifted coal or cinders may be discharged, when the sifter is lifted by its bail from the outer case. The sifter is hung on trunnions at its ends in suitable brackets fixed within the outer case, and is rotated by a crank applied to one of the trunnions, the outer case being made large enough to hold a considerable accumulation of ashes, and its close-fitting cover being left on until all the dust from sifting has settled, when the slate and clinker can be conveniently picked out, and what remains is ready to be put on the fire, the meshes of the wire cloth in the sifter being fine enough to save all the small coals. The sifter may also be made to be supported from trunnions on its opposite sides, resting in the forked upper ends of stirrups pivoted on lugs in the bottom of the case, when the sifting is done by rocking the sifter by means of a shaker bar extending through one end of the outer case. A sifter and ash receptacle of this kind can be kept and used in any room of a house, where most convenient, without scattering dust over clothing and furniture.

AN IMPROVED SIGNALING APPARATUS.

A signaling apparatus designed for a variety of purposes requiring an upwardly projected light, such as

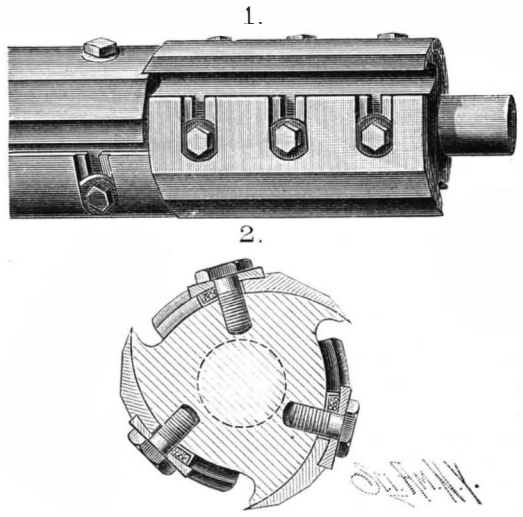


QUATERMASS' SIGNALING APPARATUS.

illuminating the rigging and signaling on shipboard, for store windows, for use on railroad trains, etc., has been patented by Mr. Reuben Quatermass, of Moline, Kan., and is shown in the accompanying illustration. A cylindrical casing, adapted to receive a lamp, is made with a perpendicular sliding door, the casing having a series of draught holes near its bottom and ledges upon its inner walls, just above the lamp flame. An inverted conical reflector surrounds the lamp, its outer edges resting upon these ledges, the light striking and being reflected upward, as shown in dotted lines. Upon a ledge in the casing, near its top, rests a glass concavo-convex shield, centrally apertured, and having a threaded collar, to which is fitted a cowl for receiving the products of combustion and allowing them to escape without permitting rain or snow to enter. Any water or snow deposited on this glass shield runs out through a series of holes in the casing in a line with the edge of the shield. By means of this lantern a column of light may be projected to a great height, illuminating the smoke and steam of a locomotive, so that they may be seen over the tops of embankments, trees, etc., and producing a halo visible at long distances.

AN IMPROVED CUTTER HEAD.

A cutter head with which the bits are interchangeable, in such manner that both ends of the bits may be worn alike, and which can be readily adjusted to balance accurately, is shown herewith, and has been patented by Mr. John C. Humphreys, of Braxton Court House, West Va. The cutter bar, stock, or bit holder has a series of exterior convex surfaces, eccentric to the axis of the cutter bar, as shown in the cross sectional view, Fig. 2, and is shaped so that, looked at from opposite ends, it presents two three-leaved cams, each of which extends half the length of the cutter bar, the bits of one series being intermediate of those of the other. The bits are secured to their places by screws passing through open-ended slots and washers in the bits, the washers fitting within countersunk marginal portions of the slots, and each washer having a pocket on its inner side in which may be placed shot or other weights, for making the different portions of the cutter head occupied by the several bits of like weight. By removing or adding weights, the adjustment can be very accurately effected without grinding the bits for such purpose, as has been common hitherto. The bits are arranged so that only one will cut at a time, and project at such tangents and are so shaped on their backs that their outer surfaces back of the cutting edges lie inside of the circle described by the cutting edges, thus cutting the wood at an angle of fifteen to twenty degrees, instead of about forty-five, as has been common heretofore. With such a cutter



HUMPHREYS' CUTTER HEAD.

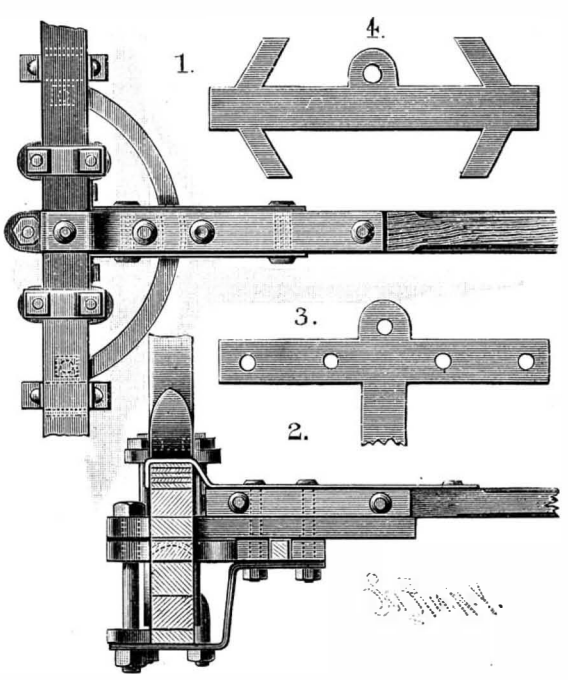
head and bits the latter do not drag and leave creases or ridges in the surface of the wood being dressed, but make a smooth cut, while economizing power.

To Free Iron or Steel from Rust.

As often happens, a chance now occurs to note a process whose value should not be underestimated. A bookbinder wishing to blacken iron places rusty iron or steel in stale beer (triple beer). After five or six days the rust is perfectly dissolved from the metal, and a dark brown to black surface takes its place. Some days later the rust reappears. This affords a ready means of cleaning old or delicate iron objects from rust.—*Uhland's Tech. Rund.*

AN IMPROVED FIFTH WHEEL.

A fifth wheel for vehicles, so constructed that it can be readily taken apart and put together, while it has great strength and simplicity, is shown in the accompanying illustration, and has been patented by Mr. Edward H. Cox, of Slate Lick, Pa. Fig. 1 is a plan view and Fig. 2 a longitudinal section, Fig. 3 showing a plan of the upper fifth wheel plate, and Fig. 4 a modified form of the lower fifth wheel, with inclined bearing arms in lieu of the base ring, for vehicles in which the front axle does not turn under. The lower fifth wheel plate, axle stock, and axle are bound together by clips passed through the usual bottom plate. The upper plate, head block, and spring are likewise bound together by clips, and the king bolt, in front of the axle, is passed through forwardly projecting eyes formed on the upper and lower fifth wheel plates and on the bottom plate. The front end of the reach abuts against the rear end of the head block, to which it is secured by the top and side stays. A reach plate of the upper fifth wheel, bolted to the under side of the reach, has a bottom extension with a downward opening slot in which the rear base ring on the lower fifth wheel is fitted to turn. An offset strap closes this slot, preventing the base ring from rattling, and the lower arm of the strap extends forward under the clip plate and receives the king bolt, on which it thus swings loosely with respect to the axle in turning. With this construction all the parts can be readily put together or taken apart, and they are not liable to quickly wear out.



COX'S FIFTH WHEEL FOR VEHICLES.

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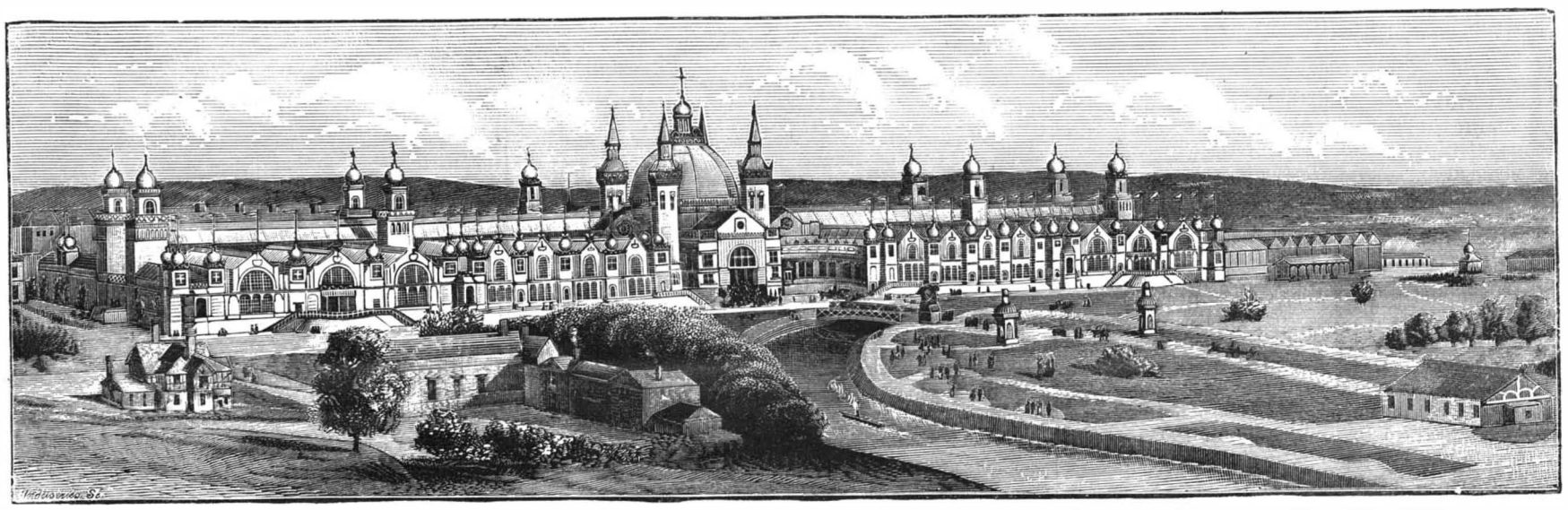
INTERNATIONAL EXHIBITION AT GLASGOW.

The buildings are now in course of erection for the great exhibition to be held at Glasgow next summer, and our illustration represents the main structure, which will be semi-Oriental in design, and which will be surmounted at the center by a dome 120 feet in height and 90 feet in diameter. The buildings will, in all, cover about ten and a quarter acres of ground. Everything relating to the exhibition is being attended to with much energy, and judging from the fact that Glasgow is the second largest city of Great Britain, with a population, including its suburbs, of nearly 1,500,000 people, and inasmuch as it is visited annually by thousands of tourists *en route* for the Trosachs and the Scotch lakes, there is no reason to doubt of the success of the enterprise. The executive council includes some of the leading nobility and most prominent citizens, and the chairman is Sir James King, Lord Provost of Glasgow. A guarantee fund of over $1,200,000 has been subscribed.

The exhibits will be of a widely different character, and will include such classes as: Agriculture, including horticulture and arboriculture. Carriages, including bicycles, tricycles, and ambulance appliances. Chemistry and chemical and philosophical apparatus and instruments. Civil engineering. Cutlery, firearms, etc. Educational appliances and apparatus for physical training. Electricity, fine arts, fishery, food, furniture, gas, and other illuminants. Heating and cooking apparatus. Jewelry machinery. Mining and metallurgy. Musical instruments. Naval architecture and marine engineering. Paper, printing, bookbinding, and stationery. Pottery and glass. Railroad appliances. Textile fabrics, leather, India rubber, gutta percha, clothing.

Great attention is to be given to the exhibit of naval engineering and architecture, and a special attraction will be the exhibit of model boats, which will be held upon the waters of the navigable river Kelvin, which passes through a portion of the park where the exhibition is to be held.

For the benefit of American exhibitors, it may be said that special rates have been fixed for the transportation of exhibits on most of the principal transatlantic lines, and these have further agreed to carry back, free of charge, all goods that remain unsold at the close of the exhibition. All applications for space, etc., should be made before November 1. The American correspondent is Mr. A. MacCorkindale, of the Mutual Life Insurance Company, New York, who is prepared to give information concerning the requirements and to furnish blanks. It would be possible for exhibitors from this country to ship goods to Glasgow, and, after the close of the exhibition, to send their exhibits from there direct to the Paris exhibition of 1889.



MAIN BUILDING OF THE INTERNATIONAL EXHIBITION TO BE HELD AT GLASGOW, SCOTLAND, IN 1888.

Lake Superior Copper and Iron.

REVIEW BY C. D. LAWTON, COMMISSIONER OF MINERAL STATISTICS.

There has been great improvement in the mining industry since one year ago; this is especially true of the iron mines. The advance in the price of copper from 10 cents per pound to 12 cents, which occurred during the past year, and which price still prevailed early in the present year, caused a feeling of relief in the copper district, the outlook became far more hopeful, and increased activity prevailed. Copper mining in Michigan has become a very uniform industry; prices may vary, but the work at the mines goes on steadily with little apparent change. There is all the while a gradual increase in the magnitude of the operations, resulting in an increased production and a corresponding lessening of cost.

Comparatively few comprehend the scale on which all the work is carried on at our great copper mines. They do not realize the fact that the rock from which the copper is eliminated must be mined far underground at a depth of from hundreds to thousands of feet, and thence be raised to the surface, taken to the rock house, and passed through breakers, whence it must go to the stamp mill—perhaps several miles away—and there it must be pounded into fine mud and sand, which in turn is run over a system of sieves, jiggers, and slime tables, undergoing an elaborate process of mechanical separation of the copper from the sand, after which the copper must be taken to the smelting works, and then cast into ingots, when it is ready to be sent to market.

Few, even mining men, who are not acquainted with the details of the work at our Michigan copper mines are ready to give credence to the statements that rock which has a gross value of but $1.65 per ton, or less than 15 pounds of refined copper, on an average, to the ton, can be mined at a depth of more than 1,000 feet below the surface, hoisted, broken, stamped, washed and separated, smelted, and taken to market and sold, and still leave a net profit of 22 cents on every ton. Yet this was the year's result at the Atlantic mine in 1885, is equally favorable for 1886, and the company paid a dividend of $1 per share to the shareholders.

In order to accomplish this, 800 tons of rock were raised and stamped per day. Each year, as the price of copper has diminished, the daily production has been increased, in order to reduce the average cost. Ten years ago, when there were but 230 tons of rock mined and treated per day, the average cost was $3.90 per ton at this mine. The cost of stamping and washing was then 88 cents per ton, while now it is but 30 cents. The total average cost per pound of copper obtained at the Atlantic mine ten years ago was 22 cents, in 1885 the same was produced for 9⅓ cents. The mine is no richer now than formerly, in fact, there has been, practically, no change in the quality of the rock. The advantage gained is due to improved facilities for mining and manipulation, to a better comprehension of the work.

The Atlantic mine has been referred to simply for illustration. There are others which afford an equally favorable showing, and altogether these results make apparent that no business in the land of equal magnitude is more systematically and carefully conducted than is the copper mining industry of Michigan. There is none more legitimate or that is conducted with more freedom from speculation and from those manipulations of stock which unfortunately too frequently characterize mining.

Copper mining in this State can be made, and is made, as certainly profitable as are other undertakings requiring large expenditures of money. The mineral lodes are pretty well understood; it is known, generally, what they will yield, the conditions are understood, the elements of the problem are in hand. The leading mines have demonstrated their ability to meet all the conditions, and to conduct their operations so that an annual profit shall accrue with assured regularity. Mining, like other enterprises, can be carried on with such recklessness and extravagance that utter ruin must result, and if there are conspicuous instances of failure in the recent history of the copper country, the unfortunate results may be traced to causes that were readily foreseen. The final outcome could have been predicted in advance with all reasonable certainty; while good management in all instances, when the conditions were favorable, has been attended with success.

The progress which has characterized the copper mining industry has also, in an equal degree, entered into the work in the leading iron mines. Copper mining of necessity requires a great preliminary outlay. The work cannot be successfully prosecuted otherwise. The rock, after it is mined, unless it is mass copper, must be crushed and stamped to great fineness, washed to separate the copper from the rock, and the copper finally smelted before it can be sold. All these successive manipulations require mechanical appliances that are elaborate and costly. Great skill and experience are essential on the part of those who have the direction of such work. No copper mine in Michigan can be successfully operated otherwise than by all this necessary outlay. As soon as the deposit has been proved sufficiently to justify its permanent working, then the rock house and stamp mill must be provided for. Hundreds of thousands of dollars must be judiciously expended before the mine becomes established as a working, paying enterprise.

Iron.—Not so with an iron mine. In some of them, in their earlier stages, it is the simplest of excavating work, a mere open pit in which the ore is dug out and loaded into cars. Generally, even when the ore is thus mined from an open cut, more or less stripping must be done before the ore can be reached. But this sort of mining is only applicable to the soft ore mines—hematites—and to these, when true of them, only in the first year or two. There are usually difficulties met with that, to be overcome, require the exercise of skill, experience, and improved appliances to insure economical production. Still the ore only has to be mined. There is no subsequent manipulation required to render it marketable.

Thirteen years ago all the iron mines in the State, with one small exception, were wholly open to daylight, and the aggregate production was 1,000,000 tons. Now nearly all are worked underground, and the aggregate production, annually, has mounted up to 3,000,000 tons. Great change has taken place in the iron mines in the last few years. In the large mines, as the Cleveland, Lake Superior, Republic, Chapin, etc., the old and inadequate machinery has given place to that of the most costly and powerful character for hoisting, for pumping, and for drilling. The wooden buildings in which the machinery was formerly held have been supplanted by stone structures with iron roofs, which are safe, substantial, spacious, and elegant. Ponderous steam engines, air compressors, and immense winding drums are the order of the day in all our great iron mines. The use of electric lighting and electric bells is becoming general. At the Chapin, Ludington, Vulcan, Lake Angeline, Lake Superior, Hematite, and Barnum mines, which have vertical shafts, cages are used instead of the skips ordinarily employed, thus securing important advantages.

The best steel wire rope is used, and catches which hold the cage should the rope break. The men are taken down into the mine or brought up from it nine at a time, without loss of time and without labor.

A New Secondary Battery.

The *Societe Industrielle* of Brussels has constructed a new accumulator, the invention of M. Tamine, a civil engineer. The element is composed of a number of connected plates for a positive and a thin sheet of lead, 1 mm. ($\frac{1}{25}$ inch) in thickness, for negative. The following is the composition of the liquid:

Saturated solution of zinc sulphate	1,000 parts.
Sulphuric acid, 10°	500 "
Ammonium sulphate	50 "
Mercurous sulphate	50 "

The solution of mercury and ammonium sulphates are first prepared. It is poured into the acid, and the zinc sulphate is afterward added. The electro-motive force is 2·3 volts. The element is formed in an acid bath. It is then slowly discharged in the liquid just described. The negative becomes covered with oxide. The discharge on open circuit is prevented by the presence of ammonium.—*Bull. International de l'Elec.*

Balloon Views of the Polar Regions.

A correspondent suggests the possibility of attaining a view of the polar regions, far beyond actual travel, by means of a photographic magnetically directed and electrically regulated (opened and closed) balloon, sent up under favorable conditions, a mile or more. It can surely be done. Of course there might be lenses on all sides of it, so as to give the view all around.

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How Stoves are Put Up.

This being the season of the year when multitudes of people are adjusting their heating apparatus, preparing for cold weather, some will recognize their own experience in the following amusing description from the *American Artisan* of the way it is sometimes done:

In the first place, the man puts on an old and very ragged coat. Then he puts his hands inside the place where the pipe ought to go, and blackens his fingers, and then studiously makes a black mark down the side of his nose. Having got his nose properly frescoed, the man grasps one side of the bottom of the stove, and his wife and the hired girl take hold of the other side, and in this way the stove is started from the woodshed to the parlor. In passing through the door, the man carefully swings his side of the stove around and jams his thumb nail against the door post. At last the stove is set down in the proper place, and the man and his wife and the hired girl set out in a triangular search after the stove legs. Two are finally found inside the stove, where they have remained since spring, and the two others are found hidden under four tons of coal. Then the old man holds up one side of the stove, while his wife puts two of the legs in place; then he holds up the other side while the other two are being adjusted, and one of the first pair is displaced. The trick of getting the four legs into their proper place is practiced with varying and indifferent results for some ten minutes, and by this time the man gets excited and reckless, and throws off his coat, regardless of the consequences.

Then the man goes for the stovepipe and gets a cinder in his eye. The stove was put up in first-class shape last year by the stove man, but this year the pipe proved to be a little too long. So the man jams his hat down over his eyes, takes a piece of pipe under each arm, and starts for the tin shop to have it fixed. Then he comes back, steps his muddy boots into one of the best parlor chairs to see if the pipe will fit, when his wife makes him come down. In the act of descending he plants his foot square down on the hollow of the cat's back, and comes within an ace of trampling the baby under foot. Then the man gets an old chair from the kitchen and climbs up to the chimney opening again, and makes the startling discovery that in cutting off the end of the pipe, the tinner had made the pipe too large to enter the hole in the chimney. So the man goes into the back yard and splits one side of the end of the pipe with an old ax, and squeezes it between his hands until he makes it smaller.

Then the man gets the pipe into shape only to find that the stove does not stand true. Then the man and his wife and the hired girl move the stove to the left, and the legs fall out again. The legs are replaced and the stove moved to the right, and there is another *seance* with the legs. Then the elbow is found not to be even with the hole in the chimney, and the man goes into the woodshed after some little blocks. Then the man and his wife and the hired girl essay to put the blocks under the legs, and the pipe comes out of the chimney. The pipe is replaced in the chimney hole, when the elbow commences to topple over. The man's wife is visibly agitated, and the man gets the dining table out of the kitchen and balances an old chair on it, and makes his wife hold the chair while he performs acrobatic feats on the grand combine, in an effort to drive some nails into the ceiling, during which performance the man drops the hammer down upon his wife's devoted head, and she surprises him with a yell worthy the emulation of a Comanche Indian.

Finally the man completes the grand act of driving the nails, constructs a wire swing to hold the elbow in position, hammers the pipe a little on one side and then a little on the other, pulls one joint a little here and pushes another length a little there, gives vocal expression to a series of deprecatory and mildly profane adjectives, takes a long breath, breathes a deep-drawn sigh of relief, and proudly announces that the job is finished.

Fine Threads.

The production of extremely fine threads of glass, quartz, and other materials has been brought to a high degree of perfection by Mr. C. V. Boys. The method which he found most satisfactory in its results was the following: A fragment of drawn-out glass was attached by sealing wax to the tail of an arrow made of a piece of straw a few inches in length; the glass was heated to a high temperature in the middle, and while the end was held in the fingers, the arrow was projected by a cross bow of pine held in a vise and with a trigger that could be pulled by the foot. With every successful shot the thread was continuous from the piece held in the hand to the arrow 90 feet off, a glass thread 90 feet long and $\frac{1}{10000}$ inch in diameter being obtained. The diameter was almost perfectly uniform for the greater part of the length. Instead of holding the glass tail in the hand, a little bead of glass may be fused on the end, and, when the arrow is shot, the inertia of the bead is sufficient to draw out the thread in the same way.

The author has also experimented upon a number of minerals, and found that while some behave like glass, others will not draw at all, being either perfectly fluid like water or when cooler perfectly rigid. Thus corundum, hornblende, zircon, rutile, cyanite, fluorite will not draw at all; on the other hand, emerald and almandine will draw, but care is needed to obtain the proper temperature. Orthoclase draws readily, but quartz, though troublesome and requiring more force, yields remarkably successful threads of extreme minuteness, in some cases tapering down to a size beyond the power of the microscope to resolve. These minute threads have some peculiar properties which the author proposes to investigate; they are highly elastic, and it is suggested that they may be advantageously used for torsion threads. They may also be preferable to spider lines for the cross wires in the eye pieces of microscopes and other instruments.—*Phil. Mag.*

A New Steel.

Prof. W. F. Barrett lately read a paper before the British Association on the physical properties of a nearly non-magnetizable steel. At the Aberdeen meeting Mr. J. T. Bottomley draw attention to a new steel recently manufactured by Messrs. Hadfield & Co., of Sheffield, which contained some 13 per cent of manganese, and was almost wholly unmagnetizable. Mr. Bottomley's experiments showed that the intensity of magnetization that could be imparted to it was some 6,000 times less than that which could be given to steel. Hence it was evident that manganese steel is a remarkable body. The author had, through the kindness of Messrs. Hadfield, and after some difficulty, succeeded in obtaining this steel drawn into wire.

One of the most curious properties of the steel is that it is annealed in the opposite way to ordinary steel, which is hardened by being suddenly cooled, whereas manganese steel is softened by this process. The modulus of elasticity of manganese steel determined by Prof. Barrett was $1{,}680 \times 10^6$ grammes per square centimeter—a singularly low value, lower than iron. The tenacity of the substance is, however, greater than ordinary steel. The breaking strain of a No. 19 wire of hard manganese steel, Prof. Barrett found, was 110 tons per square inch, nearly double that of ordinary steel wire, and only exceeded by the finest and hardest pianoforte steel wire. The resistance of manganese steel wire was found to be very high, about six times that of iron and three times that of German silver. Its change of resistance for temperature was also determined and found to be much less than iron. The comparison of its magnetic power with that of iron was examined, and in an intensely powerful magnetic field the ratio of magnetism induced in iron and manganese steel was about 1,000 to 3.

In conclusion, the author showed that manganese steel wire did not exhibit the anomalous expansion in cooling nor afterglow which is found in ordinary iron and steel wires, and thus a new connection between molecular condition and the magnetic state was revealed. Many uses of this remarkable material suggest themselves, among others the construction of iron ships with no compass error, the bed plates of dynamos, resistance coils, and non-magnetizable watches.

A New Gas Process.

The American Light and Heat Company's new process for making fuel gas was recently tried at Darby, Pa. Four retorts are used, making 50,000 cubic feet of gas every twenty-four hours. The gas is manufactured by direct process, and delivered to the holder after a simple washing. It is of 22 candle power; and there is said to be absolutely no deposit from the gas flame. The process requires oil, the diffusion of which is effected by superheated dry steam. For illuminating purposes, and on a large scale, 5 gallons of oil are stated to make 1,000 feet of gas; although 6 gallons are required at Darby. The cost is, therefore, about 30 cents per 1,000 cubic feet for 22 candle power gas. This gas has a heating capacity, it is claimed, exceeding considerably that of coal gas made in the ordinary way. At Darby it is taken a distance of 50 to 70 feet to a floor set with suitable furnaces for metallurgical purposes; and there it is used for melting steel, and for forging, welding, shaping, and manipulating iron and steel in every way. It gives a quick heat of the highest degree, 2,000° to 2,500°, cutting down every form of bar iron or bar steel placed in an opening of any one of the furnaces; and this without the use of any solid fuel. The method of developing the heat is accomplished, says a contemporary, "by using an air blast of about 6 ounce pressure, delivered into a combustion chamber from opposite sides. The illuminating gas is delivered through a one-half inch pipe, at right angles to the air pipe, and within a few inches of the outer wall of the furnace. At this point the gas and the air blast mingle, forming an explosive mixture; the combustion and evolution of heat being instantaneous. This instant production of a high degree of heat without other fuel than one volume of illuminating gas with fifteen volumes of cold air is the great characteristic. A perfect heat for melting steel (2,500°) was attained in this instance in 2 hours and 27 minutes by the use of 1,400 cubic feet of gas, as measured by the meter. The crucible on this occasion contained 100 pounds of scrap steel."

Dedication of the New Building of the College of Physicians and Surgeons of the City of New York.

The new buildings of the above college, the gift of the late Mr. Wm. H. Vanderbilt, with the building entitled the Vanderbilt Clinic, the gift of his sons as a memorial to their father, and the Sloane Maternity Hospital, the gift of Mr. William D. Sloane, were dedicated September 29, 1887. The three buildings, situated on 10th Avenue and 59th and 60th Streets, in this city, represent a total expenditure of more than double the original endowment of $500,000. The main college building, modeled in the general style of the old structure on the corner of 23d St. and 4th Avenue, is devoted to cabinets, lecture rooms, dissecting rooms, and chemical and biological laboratories, all of the most advanced type. The dissecting room will accommodate 36 tables, so that 180 students can work at once in it. It is lighted by skylights, and incandescent electric lamps are supplied for all the tables, so that work can be done in it by night as well as by day. The lecture rooms are large enough to accommodate 450 students each at one time. The clinic intended for demonstrations by actual operations includes the necessary rooms and the amphitheater to be the scene of many conflicts with accident and disease. The Maternity Hospital, severely finished in its interior with white marble, contains 30 beds free in perpetuity. The exterior of the buildings is of brownstone and brick. In the dedication, the leading members of the medical profession and many leading citizens participated.

The Nesting Spider.

Dr. M'Cook gave, before the British Association, the result of observations on the nesting habits of *Atypus niger*, a Florida spider. Referring to the original description of the black atypus of Florida, made by Hentz in his "Spiders of the United States," Dr. M'Cook said that a good drawing of the species had been made by an Englishman, Mr. John Abbott, as early as 1792. Mr. Abbott quite happily described the creature as the "purse web spider," and made a brief and correct note of its habits. The nests of the black *Atypus* are silken tubes of close texture, and various lengths and sizes, which are spun against the bark of trees, nearly equal portions being above and below ground. Some of the tubes are 12 inches to 14 inches long, and one-half inch to three-fourths inch in diameter. Others, the nests of the young, are a few inches long and the thickness of a pipe stem. The inside of the nests is quite white and clean, the outside is weather-stained and covered with sand. The mode of spinning these was described in the paper. The work is done in sections, the length of the tube being accomplished by adding to the original section until the desired length is attained. The new-made tubes were found covered on the outside with sand. The spiders were not seen in the act of sanding their nests, but a similar habit in *Atypus piceus* of England has been well observed and freely described by Mr. F. Enock, who made the interesting discovery that the sand is forced through the texture of the web from the inside.

The close relations were pointed out between the nesting tubes of *Atypus niger* and *Atypus piceus*. The chief differences seemed to be that the former suspends the exterior part of its tube against the trunk of a tree, attaching it thereto by threads, while the latter suspends it to stocks of grass and weeds, or trails it along the ground among the herbage. It was, said Dr. M'Cook, interesting to compare the nests of the group of spiders known as the tunnel weavers, to which *Atypus* belongs. Beginning with the great hairy spider, tarantula, the giant of the order, we have a simple burrow, whose opening is sometimes covering a patch of spinning work. Second in the series may be placed *Cyrtochenius elongatus*, whose nest is a silk-lined burrow, the lining of which is carried above the earth in the form of a funnel-shaped tube. In the nest of *Atypus piceus* this funnel appears at times as a long tube of nearly uniform size, extending horizontally along the ground. Next comes the nest of *Atypus niger*, already described, and then the trap-door spiders of various American and European genera.

After further tracing the tube-making habit, Dr. M'Cook mentioned a fossil spider which he had seen in the British Museum. This fossil was taken from the Eocene tertiary at Garnet Bay, Isle of Wight, and might be the distant progenitor of the present British species. It was evident that the genus has undergone little or no change since this, its first apparition.

The Soda Engine.

Referring to repeated recent statements that "soda" locomotives had been adopted for use in the streets of Minneapolis, Minn., *Wood and Iron*, of that city, says: During last winter and early spring some experiments were made with a so-called soda engine, and the "soda engine" did make a few trips with a steam engine in attendance to help it out of difficulties. These "soda" engines were abandoned several months ago, after an expenditure of more than $50,000 in a vain attempt to make them successful. We do not believe that the failure was due to the use of soda, but to poor management, bad designs, and worse workmanship.

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MACHINES FOR MAKING PACKING BOXES.

The new and curious machines that we are about to describe are of American origin, and are designed for the manufacture of packing boxes.

The wood, in the form of boards, after being sawed into pieces of the proper dimensions to form the sides of the box, is planed by powerful machine tools, which, while making it even and smooth, regulate its thickness. The pieces are next printed with characters in black in a rotary machine analogous to a newspaper press. This operation is performed very quickly. In

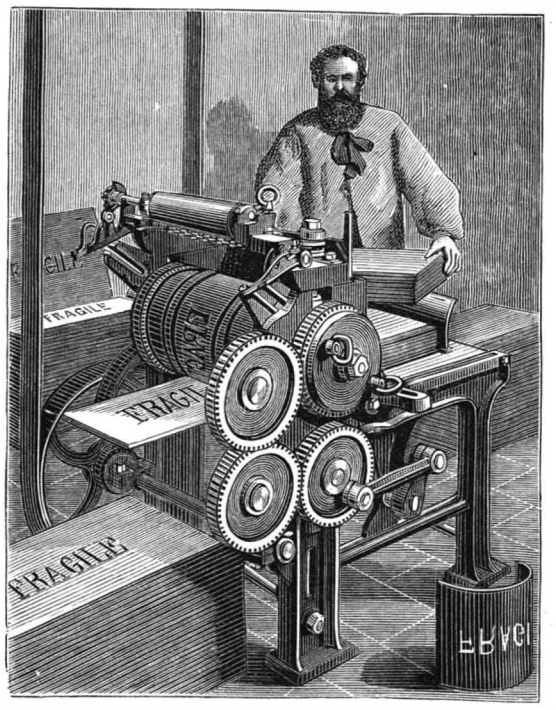

Fig. 1.—MACHINE FOR PRINTING ON WOOD.

addition to its being printed with an indelible ink, the inscription is stamped in the wood, thus making it ineffaceable.

The machine that does this (Fig. 1) consists of a table, an ink block with its inking rollers, and two cylinders, the whole actuated by gearings and pulleys.

The workman places a pile of the prepared wood on the table, and a tappet actuated by a rod beneath the table shoves out the bottom piece from the pile, and this is caught between the cylinders, which carry it along and print an inscription on its upper surface, as shown in the engraving. Immediately, and at every revolution, one of the pieces is printed and put upon the pile in front of the machine. Above the upper cylinder is placed an ink block, which, through an arrangement that is as simple as ingenious, deposits the necessary quantity of ink on the type.

The printed wood is next passed to the nailing machine (Figs. 2 and 3), which is actuated by a belt running over a pulley driven by a line of shafting. The workman, standing in front of the machine, places his foot upon a pedal which acts upon a coupling box that throws the machine into gear. In a single revolution, the pieces to be united are assembled and fastened to each other by a series of nails, varying in size according to circumstances, and brought under the hammers by vertical tubes.

A boy, standing upon a platform, places the nails in buckets attached to the links of a chain belonging to the machine. The nail is put head downward into each bucket, then every revolution of the machine moves the chain forward by one line of links and empties the nails, point downward, into the tubes, A (Fig. 3). In order to facilitate the entrance of the nails, the tubes are provided with a hopper at the top. Beneath, the nails enter the hammer boxes obliquely. When the machine moves, the hammer rods rise, the nail slides into the lower part of the box, which presses against the wood to be nailed. The hammer at once falls and drives the nail into the wood by pressure, and without a blow. The motion of the machine is at once arrested, and the wood being set free, the workman reverses it or replaces it, and then, pressing the pedal again, drives in another series of nails at the place presented. The nails are driven very regularly, and are very firmly embedded in the wood. Each machine daily drives, on an average, more than 24,000 nails, weighing altogether about 285 lb. Each box consists of from 18 to 20 pieces of wood, all sawed out mechanically to fixed dimensions, and which pass successively through twenty or twenty-five hands.—*La Nature.*

Fig. 2.—NAILING MACHINES IN OPERATION.

Action of Magnets on Liquids.

Some weeks ago, one of my students, Mr. J. C. Child, and myself were working with a diamagnetic instrument, simply repeating well-known experiments. Plucker's method of observing the diamagnetism of liquids having failed in our hands to give satisfactory results, we hit upon a method which was new to us, and which was very satisfactory. Into a glass tube of about four or five millimeters internal diameter a small quantity of liquid was introduced, forming a short cylinder. This tube was placed horizontally at right angles to the line joining the poles of the magnet, with the liquid nearly between the poles. When the current was turned on, the liquid was very evidently repelled. Water was repelled through a distance of about half a centimeter; wood spirit through a greater distance. By moving the tube in the direction of its length, the wood spirit could be pushed any distance through the tube. The amount of motion is of course a function of the resistances due to adhesion and friction as well as of the repulsive force. The attraction of liquids is easily shown by the same method.

A single modification of the above plan of proceeding is to incline the tube slightly, so as to make the liquid flow toward the poles. If the required velocity be not too great, the magnet acts as a break to stop the motion. It is well to bend the tube up a little at each end to prevent the liquids from flowing out. This method is well adapted for projection so as to be seen by large audiences. S. T. MOREHEAD.

Washington and Lee University,
Lexington, Va., May 9, 1887.

—*American Journal of Science.*

Subsidence of the Earth over Salt Mines.

Mr. Thomas Ward read a paper before the British Association entitled "The History and Cause of the Subsidences at Northwich and its Neighborhood in the Salt Districts of Cheshire." He said:

Northwich overlies extensive beds of salt, occupying about three square miles. The first or "top" rock salt lies at a depth of about 50 yards from the surface, and is covered by Keuper marls, and these by the drift sands and marls. Between the two beds of salt there are 30 feet of indurated Keuper marl. The second or "bottom" rock salt is over 80 yards in thickness. These beds of salt occupy the lowest portion of an old triassic salt lake. The first bed of rock salt was discovered in 1670, the second in 1781. The falling in of a rock salt mine is a very rare occurrence, and subsidences of this kind do not give rise to the reports which are met with in the newspapers.

The first reported destruction of a mine was in 1750, and from that date to the end of the 18th century every two or three years a mine collapsed. In the present century, at considerable intervals of time, collapses of mines have occurred; but these, with scarcely an exception, were old, abandoned "top" mines. The subsidences which are so destructive in the town of Northwich and the neighborhood are entirely caused by the pumping of brine for the manufacture of white salt. It was only about 1770, or shortly afterward, that the first sinking was noticed. Since that date subsidence has gone on very rapidly, and much destruction of property has resulted. Large lakes, or "flashes," one of more than 100 acres in area, and of all depths up to 45 feet, have been and are being formed. The brine pumps set up a circulation of the salt water, or brine, lying on the rock salt, which flows to the pumping center. The brine thus removed is replaced by fresh water, which on its passage to the pump saturates itself, taking up sufficient salt to make a solution containing about 26 per cent of salt. This continual removal of salt from the surface of the rock salt lowers it, and the overlying earths either follow the diminishing surface continuously or else, after remaining suspended for a time, suddenly fall into the cavity from which the water has extracted the salt. The brine currents, on their way to the pumping centers, form deep valleys or troughs, and the surface of the ground overlying forms a fac-

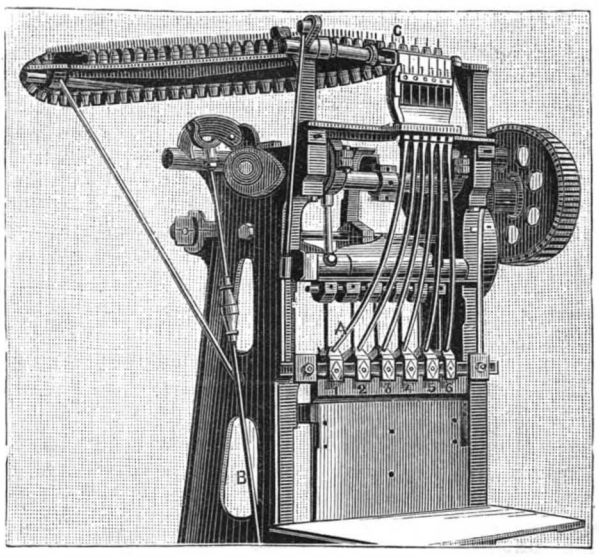

Fig. 3.—DETAILS OF A NAILING MACHINE.

simile of these hollows. The property on the sloping sides of the valley is pulled to pieces and destroyed; the windows and doors all get out of form, owing to the unequal sinking of the various portions of the house. When, owing to the different nature of the marls and the abundance of sand overlying them, a sudden sinking takes place, the hole extends to the surface and swallows up anything upon the surface—as a horse in a stable, barrels of beer in a cellar, or water butts and other utensils in a yard. The damage done to property is enormous, but thus far no human life has been lost.

Treatment of Sciatica by Refrigeration of the Sound Limb.

Some time ago, M. Debove announced that he had been able to afford marked relief in a case of obstinate sciatica by means of a spray of chloride of methyl applied along the course of the sciatic nerve in the unaffected member. At a recent meeting of the Societe de Biologie (*Le Concours Medical*, August 6, 1887), M. Raymond reported that he had obtained favorable results by a similar method in three cases. He found, however, that the effect was the same even when the spray was directed to any part of the limb, and not necessarily along the course of the sciatic nerve. This would seem to prove that the relief of the pain was due to an impression made upon the spinal centers by refrigeration of the peripheral nerve terminations, rather than to a direct influence exerted upon the trunk of the affected nerve itself, or of its fellow in the opposite limb.

ON the occasion of the new issue of coins in England in the Queen's jubilee year, the iron dies from which the coins were struck were made by electrolysis. The plaster moulds of the originals first received a coating of copper, and on the template thus formed the iron was deposited. According to Prof. C. Roberts-Austen, Chemist of the Royal Mint, London, the iron was of excellent quality. A current of 0·089 ampere from two Smee elements was used. The solution consisted of sulphate of iron and sulphate of magnesia of specific gravity 1,153, in equivalent proportions. This solution was almost neutralized with carbonate of magnesia until it gave a very feeble acid reaction with litmus. In Russia, plates of iron thus obtained are used for printing bank bills.—*Ann. Industrielles.*

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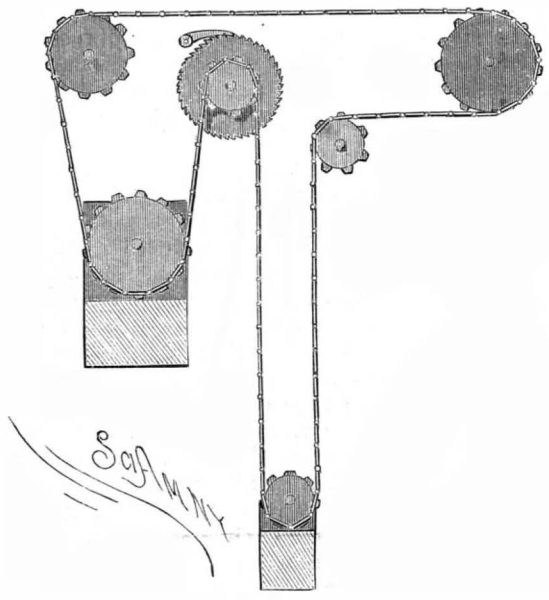
HARVARD OBSERVATORY AND THE HENRY DRAPER MEMORIAL.

(*Continued from first page.*)

constitute the principal working portion of the observatory. The most important work done is of the photographic class, and it is this division that we particularly describe. Prof. Pickering, however, is also engaged on another investigation, which we can only allude to—the photometry of stars. This is executed by himself personally, with an assistant. A polarization photometer is employed. The results are of much practical value for use in connection with astronomical work, and when completed are destined to form a most important standard of reference.



HUYGHENIAN MOTION.

In a recent article on the Alvan Clark establishment, where the great telescopic objectives of the world have been ground, reference was made to photographic objectives. The photographic objectives used by the Harvard observatory owe their excellence to the Clarks. Such glasses have to be ground with a special view to focusing the actinic rays. A perfect photographic lens would be quite useless for visual work. In testing them, therefore, recourse is had to photography. Photographs are taken of a star, generally Polaris or the pole star, on both sides of the chemical focus. If the lens is such as to bring all the actinic rays to a focus, the effect of photographing the star as described will be to produce a series of images, varying from a disk to a mere point, and then increasing in size again to a disk. The disks will be given by photographs out of focus, the point representing the focused view. If the lens is perfectly ground, these disks will appear all as evenly illuminated images upon development of the plate. If the lens is out of adjustment, one portion of the disk will develop darker than the rest. We illustrate a series of representations of such test photographs, of the precise size of the originals. They were taken on the same plate of glass exactly as shown. One of the disks on the side showed a spot in the center, indicating a faulty shape, which had to be remedied by the manual skill of the Clark brothers, from whom the plate shown was procured. The spectrum test is illustrated also. In this a spectrum of a bright spot is photographed of the size shown in the cut. Such portion of the rays as are brought to a focus will produce a spectrum of even width. If the more actinic portion acts thus, the lens is proved correct. The spectra shown, also from the Clark brothers, taper to a point, the broad portion being out of focus. Hence the lens was out of adjustment. The interpretation of these results demands the highest order of skill in the maker of the lens, and it is not too much to say that the high quality of the Harvard observatory work could only be obtained through, and is due to, the unrivaled talent of the makers of the objectives.

The telescope shown in the illustration on the first page is contained in a small gable-roofed house. The instrument is erected on a very solid foundation, one which had been used in observing the transit of Mercury in 1878. Attached to its base is a circular level of exceedingly great delicacy, by which it can, when necessary, be adjusted. The building in which it stands is rather peculiar. The gable roof is in two sections, being divided across its center, and is mounted on wheels running on tracks parallel to the ridge. When the instrument is in use, these two segments are pulled apart, to the entire length, if desired, of the building, the rails in prolongation of the plate beams being carried outside on each end of the house a distance equal to one-half its length. The mounting of the telescope is also peculiar. A steel tube is carried by trunnions in the end of a large fork. Into this tube the brass tube containing the lenses is screwed. The polar axis is in prolongation of this fork. Hence, if the glass is directed to a given star, and rotated on the axis with sidereal time, the star will occupy the same position in the field of view.

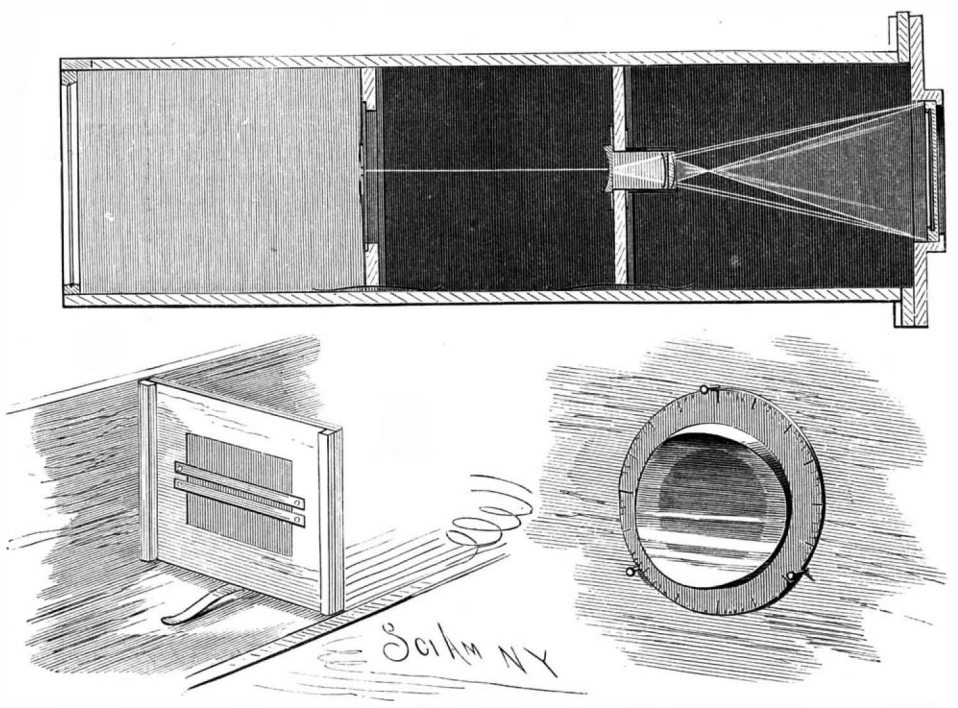
As a simplification of the usual methods of mounting, the plan is of interest. The telescope is carried symmetrically, so that no counterweights are needed. This saves weight. With it any star can be followed uninterruptedly from rising to setting. Polar stars are as easily kept in the field as any others. It does not seem well adapted for visual work, as the fork mounting would interfere with the observer in the case of polar stars.

The lens is a Voightlander photographic objective of 8 inches aperture, and about 45 inches focus (exactly 114·6 centimeters). To adapt it for stellar work, two of the faces had to be reground. This brought it into perfect condition. With it much work was done in stellar photography under an appropriation from the Bache fund of the National Academy of Sciences, awarded in 1885. It is now devoted to photography of spectra. In front of the objective a battery of two prisms is carried. At the other end of the tube a sensitive plate occupies the position of the focus. By this extremely simple method, first suggested by Fraunhofer, the spectra of numerous stars are obtained upon a single plate.

For driving it the Huyghenian motion is used. The peculiarity of this system is that it can be rewound without affecting the running of the apparatus. The wheel furnished with a ratchet wheel and pawl is the winding axle. When this is turned, the large driving weight is raised and the small weight descends. But during the winding the driving wheel, the one to the extreme right, is continually urged to rotate just as when the winding ceases. The driving weight never ceases to exert its pull upon this wheel, which represents the drum of the ordinary gravity train.

PHOTOGRAPHIC TESTS OF OBJECTIVE.

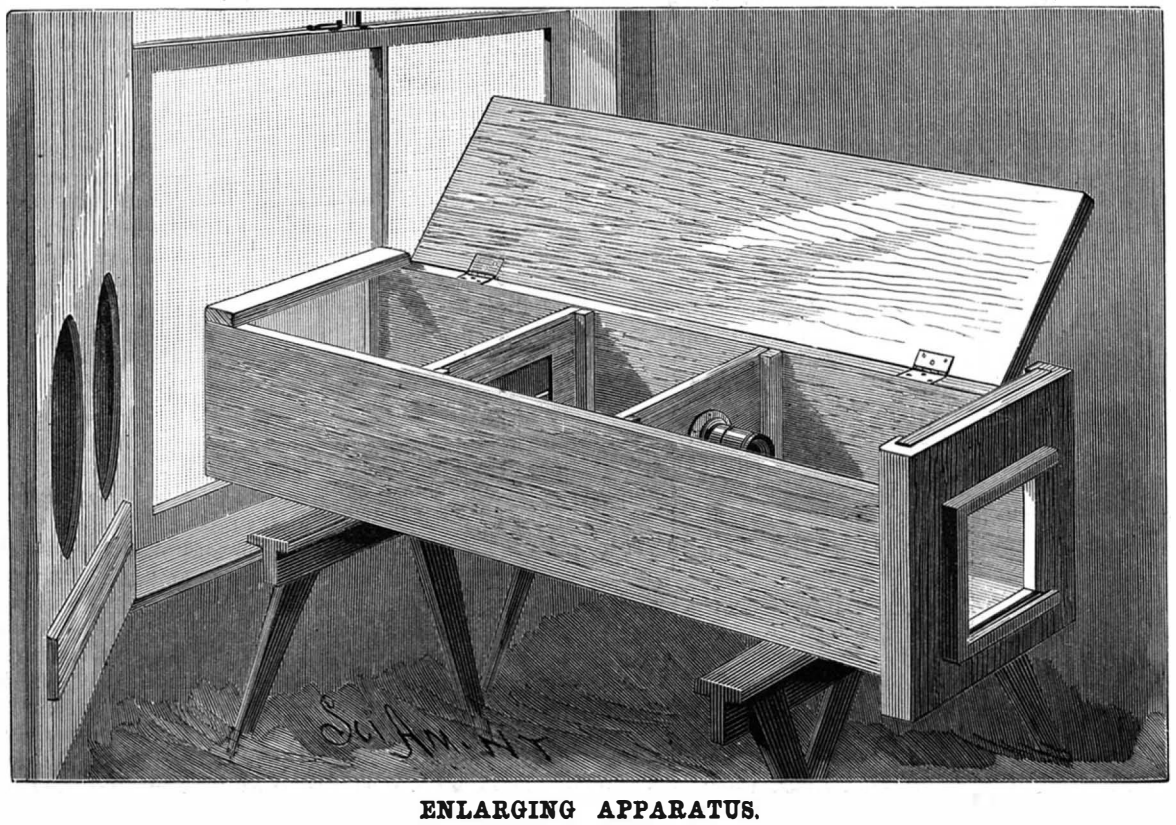
The original work done by this telescope was purely photographic. Under the Bache appropriation, the investigation took the direction of stellar photography. Under the Draper memorial fund, the work of stellar spectroscopy was taken up. The work is now carried on in the following manner.



SECTION OF ENLARGING APPARATUS, WITH CYLINDRICAL LENS.

The prisms are set with their edges horizontal, so that the spectra are vertical. By five or six trials the adjustment for focus is secured, and this lasts for an indefinite period. If now a photographic dry plate is exposed while the instrument rotates by sidereal time, the spectra of all the stars in the field will fall upon the sensitive plate. However long exposed the plate was, assuming all to be in accurate adjustment, the spectra will appear as very fine lines. Their width in general terms is equal to the diameter of the images that would be photographed were the prisms removed and the telescope directed upon them. The largest of the stars would give only a thread-like line to represent its spectrum. The width of this has to be increased for the spectrum to be visible. While this might be done by magnifying the image, a very ingenious application of the principle of "trailing" is used to partially effect the desired result. If the telescope were kept immovable, the stars by the rotation of the earth would sweep across the field of the instrument. This motion with the prisms in place would affect the spectra in the same way. They would be widened into bands. Except in the case of stars near the poles, the motion of the stars across the field would be far too rapid to sufficiently affect the sensitive film, were the telescope kept motionless. Hence in practice it is rotated, but at a rate slightly less than the angular motion of the earth. This slowly widens the spectra, but allows them to act for a long enough time upon the plates to produce a good actinic effect. The exposures under present practice are in the neighborhood of one hour's duration. In this way, instead of narrow, line-like spectra, bands a sixteenth of an inch wide or more are produced. In a subsequent issue we will show how these spectra thus produced appear.

The relative action of the different parts of the apparatus is now clear. The light from the stars strikes the faces of the prisms, and passes through them. The pencil of light from each star is thus refracted, and produces a spectrum with vertical axis and horizontal lines. This falls upon the photographic objective, and is



ENLARGING APPARATUS.

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brought thereby to a focus at the lower end of the tube. There it is received upon the sensitive plate, while the telescope by its motion, slightly slower than that of the earth, draws the image out so as to increase its horizontal dimensions and amplify the breadth of the spectrum.

After a sufficient exposure, the plate is taken from the telescope to the dark room and is developed. From the negative thus produced a greatly enlarged positive is produced by the use of the apparatus shown in the cut. The negative is set on edge in a box with ground glass, and by two brass strips and dark paper it is completely covered, except the narrow area containing the spectrum. Next to this a concave cylindrical lens is placed. Owing, it may be, to irregularities in the motion of the telescope or to changes in the transparency of the air, the spectra always contain a number of longitudinal streaks. The cylindrical lens, by its dispersive effect, destroys this imperfection. A photographic lens receives the light transmitted through the negative and cylindrical lens, and brings the image to a focus where the image falls upon a sensitive plate. The horizontal streaking is not the only defect of the original spectra. Owing, probably, to variations in the refractive power of the atmosphere, the lines or bars are not perpendicular to the axis of the spectrum. The cylindrical lens is mounted so as to be susceptible of rotation. It is for each spectrum so turned that its axis shall be perpendicular to the inclination of the bars.

The general process is the familiar one of photographic enlargement. Its most characteristic feature is the use of the cylindrical lens and of the metal strips and screen. Great care has to be exercised in this part of the operation to keep the edges of the metal strips clean. Little particles of dust might otherwise appear on the magnified image as spectral lines.

The plate, after due exposure, which is executed by daylight, is developed, and gives a spectrum that may be several inches wide and proportionately long. The bars still appear as crossing it at an angle. To produce a straight spectrum, a portion is marked out, giving the lines at right angles to the axis. Thus the faint light of the stars is re-enforced by the daylight, which produces the enlargement and which acts like a telegraphic relay.

Such is a brief summary of the methods as now used. The work is still in development. A great many of the spectra are photographed with a large glass and with prisms of higher dispersive power. Neither can the full scope be understood or the progress of the last few years be grasped without an inspection of the different final photographs and of the successive stages in their production. This and other points will be reserved as the subject of a second article on the Harvard observatory.

Metallurgical and Mechanical Progress.

In a paper lately read before the Iron and Steel Institute, by Thomas Ashbury, the author gave a rapid survey of the various exhibits in the machinery and metallurgical sections of the Manchester Exhibition, from which we abstract the following:

The method of manufacturing rollers for spinning machinery was examined in connection with Messrs. Joseph Webb & Son's exhibit. The iron for these rollers must be, said the author, of a very close-grained and sound quality. The bars are first cut to length, and calendered or straightened, after which each piece is put into a lathe, ended up, and centered at one end. By means of a Ryder's forging machine, a square end and neck is formed, after which a hole ½ in. diam. and 3 in. long is put in at the end of the roller opposite to the forged end. The next operation is that of punching, and by means of a number of square punches forced quickly, one after the other, into the round hole, it is squared up to the exact size. As this operation is performed on the iron while cold, it is, of course, a very severe test, and unless the iron is of good quality it will split. After punching, the square end is centered and ended, and the roller is stretched very straight and true. The square end is now machined exact to size, to fit the punched hole, so that no filing is required when coupled up. After this the opposite end of the roller with the square hole is ended up to the exact dead length to special gauges, so that when seventy or eighty rollers are coupled together in one line they fit the machine exactly, without the slightest variation in length. After coupling, marking, turning, and stretching, the rollers are fluted on a machine which will flute forty-eight at once. There are usually from forty-three to fifty-five flutes to the inch, the different kinds being suited for spinning long or short staple cotton, and varying according to the number of counts required. The rollers are then carefully examined, and the defective ones rejected, after which all joints are eased and tested so as to be of one uniform tightness. Seventy or eighty rollers are now coupled, and run in one line to be quite sure they are true. They are then polished and packed. Steel has recently been tried for rollers, but, although it is clean and tough, it is more costly to turn and flute, and in consequence of the necks wearing so rapidly, the life of a steel roller is much shorter than that of an iron one. An iron roller will last from ten to fifteen years, while a steel one only lasts from one to three years. The steel roller is thus of little use except it be casehardened, and to do this entails considerable extra expense, for besides the cost of casehardening, the rollers have to be again straightened, and this is no small task, as they are very crooked when they come out of the hardening furnace. They have also to be repolished and carefully examined. The endurance of a casehardened steel roller has not yet been ascertained.

In reference to the exhibit of the Steel Company of Scotland, Limited, the author described it as being built in the form of a trophy, the corner columns being formed of bars of angle, bulb, and T sections, with rails of various sections. The entablature is framed in plates and channels ornamented with sections of smaller angle, girder, rail, and bar steel. A marine boiler, the front plate of which is shown with flanged openings for furnaces, spans the top. Under the canopy, castings and heavy girder types of tramway rails are shown.

In connection with the exhibit of Messrs. Sir Joseph Whitworth & Co., the author said that in the Whitworth system of forging hollow steel shafts, among the many advantages claimed may be named the facility with which, in the initial stages, defects of any kind can be discovered. By the absence of the central core, a thorough, uniform heat is obtained, unequal strains are avoided, and an absolute uniformity of the material is insured. And by the steel being worked thoroughly from the inner as well as the outer surface, there is secured a regular and even amount of work on all portions of the forging, with the advantage of the material not being unequally strained, as in forging under a steam hammer; but a perfectly uniform consolidation of all the portions of the forging is attained, with a gain of strength by a better disposition of the material, so that with a reduction of strains, and much greater elasticity, there is less liability to fracture. The propeller shaft shown by the firm is 55 ft. long and 18¼ in. diam., with a collar at one end 34 in. diam. by 5½ in. wide, a hole 10 in. diam. being left the full length of the shaft. This hole is just as it was left in the forging, and has not been bored. The truth of the shaft is remarkable, as will be seen from the short lengths turned, not more than $\frac{1}{16}$ in. difference being noticeable between the forged outside diameter and the finished turned-up diameter. Another exhibit is a portion of a Whitehead torpedo, being the section of the torpedo which contains the compressed air for supplying the propeller engines. This shell or casing is about 14 in. diam., with a thickness of metal ranging from ¼ in. to ⅓ in. These torpedo air receivers are tested by Admiralty officials up to 1,500 lb. per square inch, while tests up to as high as 3,350 lb. per square inch have failed to rupture or damage the shell. In the year 1881 the Brazilian government ordered in this country an iron-clad man-of-war, called the Riachuelo, and part of her armament was four guns of 20 tons each, for which the specification and tender of Sir Joseph Whitworth & Co. was accepted. One of the results guaranteed by the firm was that in a trial the gun should send a 400 lb. projectile through a solid iron armor plate 18 in. thick —an achievement that had never before been either promised or accomplished. On the completion of the first gun, it was subjected to a trial on the sands at Birkdale, Southport, to ascertain whether the stipulated conditions had been fulfilled. For testing penetration, a target was made as follows:

A solid wrought iron armor plate, 18 in. thick, as made by Messrs. John Brown & Co., Limited, was supported by a steel cylinder 37 in. long, with a bore of 23 in., filled with wet sand, and rammed quite hard. Supporting this was a steel plate 2¼ in. thick, stiffened and supported by 6 in. T pieces, and filled up solid by a series of oak balks 7 in. thick. A further support was given by a large cast iron bed plate 20 ft. long, 5 ft. wide, and 14½ in. thick, which was put on the flat, across the center of the target, and arranged to form a powerful stay, or strut, to support the target backing. The outer end rested on timber at the floor level, and abutted against some piles. These were further supported by large balks of timber laid longitudinally, the ends of which were buttressed by another row of piles, behind which, and covering the whole structure, was a heap of wet sand, well rammed, about 7 ft. thick. The gun was placed 90 ft. from the target, and a charge of 197 lb. of black prismatic powder was used. The weight of the shell was 403 lb. It was made of Whitworth metal. The velocity was about 2,000 ft. per second. The shell, when fired, hit the center of the 18 in. armor plate, and completely penetrated it, giving to the hole made by its passage a twist corresponding to the twist of the shell. It also completely passed through the 37 in. of hard rammed wet sand, and burst in two pieces the heavy steel hoop containing the sand. It then passed clean through the 2¼ in. steel plate, the T iron backing, and the 7 in. of oak backing. The shell finally hit fair on end the center of the heavy cast iron plate, smashed it up completely, and the debris deflected the shell so that it buried itself 4 ft. down in the solid earth, 17 ft. 6 in. away from the target. The Brazilian government officials, who witnessed the test, reported that the force expended, after passing through the 18 in. solid iron armor plate, was equal to having made a total penetration through an iron armor plate 23 in. thick. The 9 in. shell exhibited is the actual one which went through the 18 in. armor plate, on which it now rests in very much the same condition as when dug out of the earth, and the only punishment shown by the shell is that the nipple is slightly compressed and a slight twist given to it.

The Lucigen.

A very successful demonstration of its great lighting powers was recently given at the Crystal Palace. The method of producing this light consists in forming an intimate mixture of air and minutely divided oil particles, resulting, when ignited, in a continuous, steady flame of great brightness. The mechanism, which is very simple, is worked by a small supply of compressed air, and the flame is under perfect control by merely turning a tap. As the light is produced by the combustion of crude and waste oils, its cost is, by actual measurement by the official gas analyst for Glasgow, found to be from one-tenth to one-twelfth the cost of gas, and about one-twentieth that of electric light of the same actual candle power. It is stated that an area of half a square mile can be flooded with light equal to daylight at an expenditure of one shilling and threepence per hour. As shown at the Crystal Palace, the lucigen illustrated very perfectly the great volume of light it is capable of giving out. It was found that ordinary manuscript could be read at a distance of 150 paces from a jet which was stated to cost 3d. per hour. The great value of this light lies in its diffusiveness, which adapts it so admirably for use on works or where any outdoor operations have to be carried on at night. The true principles of useful lighting, it would seem, are only now beginning to be understood. It has always been overlooked that the eye is the first factor in determining the success of illumination, as it is by the aid given to accurate sight that work is to be done. Now, the amount of light the eye will receive depends on the size of the pupil, and this latter depends on the intensity of the source of light, and not on the amount of light given out. Should the intensity be great, the pupil closes so as to protect the delicate retina from injury, and hence the eye receives little of the light reflected from surrounding articles, and the illumination appears very bad. Should the intensity be low, then the pupil does not close nearly so much, and surrounding articles seem much better illuminated. Hence a naked arc lamp in a room is so blinding that work cannot be done; but when an opalescent globe is placed over it, so as to reduce the intensity, the eye sees details in the room much better, although the opalescent globe has cut off three quarters of the light. Looked at in the light of these explanations, the effect of the lucigen may be imagined, as it is said to produce a flame of 3,000 actual candle power, or equal to six large arc lamps, while its radiative surface is about 350 square inches, as against one square inch for the arc lamp. The result is that the lucigen gives a light of a quality highly effective for working purposes.

The lucigen marks the latest advance in the history of the production of light from carbonaceous substances, as not only does it raise the carbon particles to the most intense white heat, but the form of the flame is such as to retain them in that condition for the longest period. The lucigen has been adopted at a large number of works in this country, including those of the Forth Bridge, and it is also in use by the French government for military operations.—*Iron.*

Changes in Milk Produced by Freezing.

BY KAISER AND SCHMIEDER.

Two samples were experimented with. One was frozen slowly, the other quickly, and afterward partially thawed. In the former case, the ice contained the greater part of the fat and the fluid portion most of the casein, milk sugar, and salts. In the quickly frozen and partially thawed sample, the fat was equally distributed between the solid and fluid portions. The author explains this by the fat globules rising to the top when the process of freezing is gradual. They thus become embedded in the flakes of ice; while in quickly frozen samples this cannot take place, and the fat is more evenly distributed. If a dealer whose milk has been frozen pours off the clear fluid which underlies the ice, he is liable to the suspicion of adulteration on the one hand or will deliver milk above the standard on the other. Milk which has been frozen should be well thawed and shaken up, and not sold while any ice is visible.—*Bied. Centr., from Jour. Chem. Soc.*

The Silver Molecule.

In an exhaustive paper upon methods of measuring thin films, Otto Wiener makes certain measures of the thickness of a film of silver which can just be perceived by the eye, and arrives at the conclusion that 0·2 millionths of a millimeter is an upper limit of the diameter of a silver molecule.

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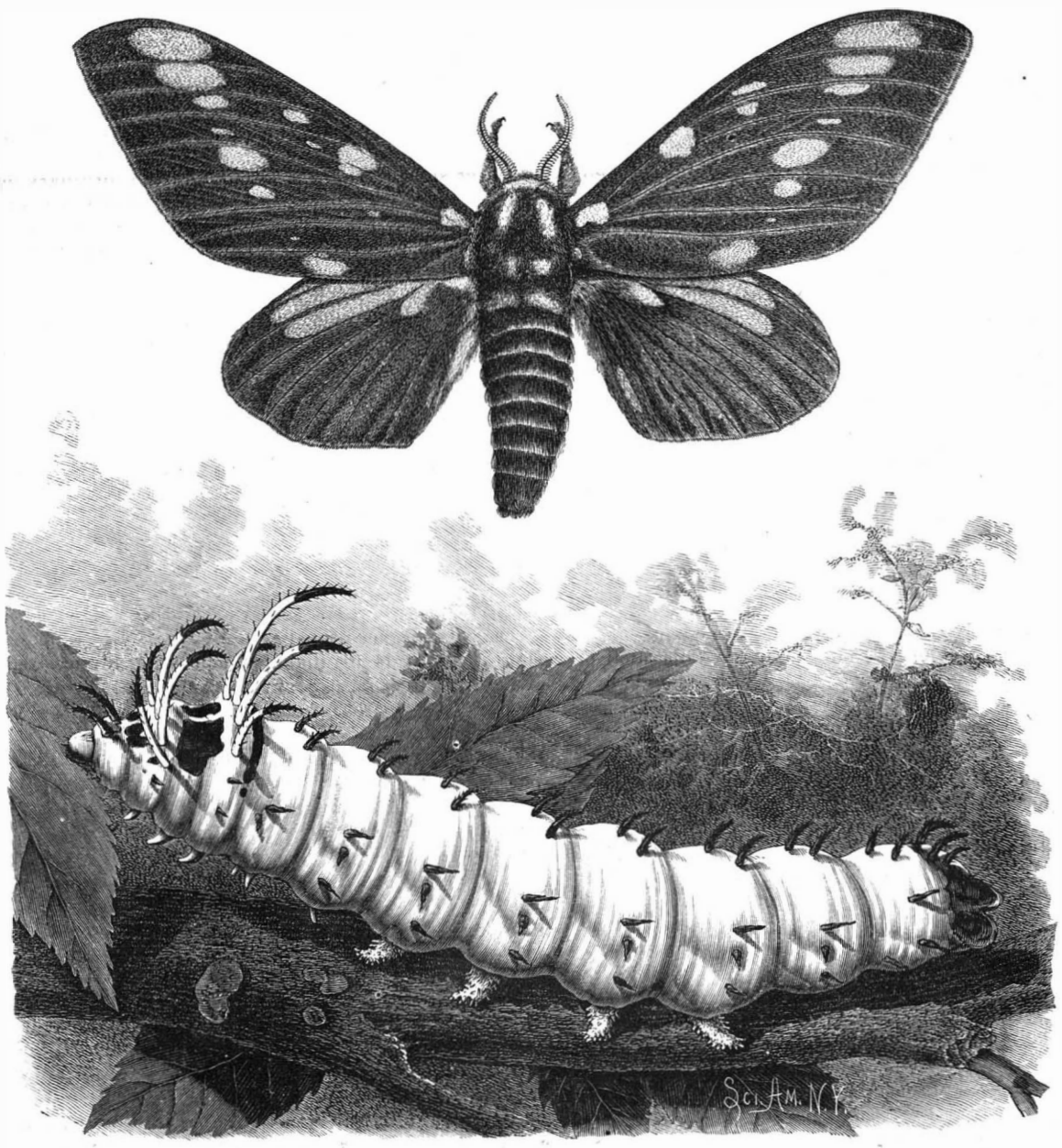
THE REGAL WALNUT MOTH.

One of the largest and rarest of our native moths is illustrated by the accompanying cut, in which the imago and caterpillar of the *Ceratocampa regalis* or regal walnut moth are represented. This beautiful insect, in the winged state, flies during the nights of June and July, and can be found at rest with closed wings on fences or old trees during the day. The moth, when expanded, measures from five to six inches across the wings, and its fore wings have an olive-colored ground ornamented by several yellow spots and heavy red veins, while the hind wings are orange red, and each one has two irregularly shaped yellow patches and a row of wedge-shaped olive-colored spots. The head and body of the moth are colored orange and red like the hind wings, and the head is also adorned with two prominent feathered feelers. The thorax is yellow, with the edge of the collar and the shoulder covers of orange red. A large orange red spot is also found on top.

The females of this species of moth lay their eggs on the black walnut or hickory trees in July, and the caterpillars make their appearance about the beginning of August. The caterpillars feed on the leaves of black walnut and hickory trees, on which the eggs are hatched, and when fully grown attain the size represented in our engraving, measuring from five to six inches in length and nearly an inch in diameter.

The ground color of the caterpillar is green, with a pale blue band on each ring, and a large blue black spot is found on each side of the third ring. The most remarkable and attractive features of this caterpillar are its two rows of long, thorny horns or spines on the second and third rings of its body. The horns extend upward and are gracefully curved backward, being of an orange color, with black, pointed ends, and similarly colored minute thorns or projections throughout their length. The smaller black spines are formed on each ring. The great size of this insect and its long horns give it a wonderfully fine appearance when at rest, but when it is in motion, crawling along the twig of a tree and shaking its head and horns from side to side or moving them up and down, it becomes really frightful to behold, although it is perfectly harmless and cannot wound or sting with its horns or spines.

When through feeding, the caterpillar leaves the lofty branches of the tree and crawls down the trunk to the ground, and there searches for a convenient place to change into a chrysalis. In this restless state it is frequently found crawling along a roadway or board walk. As soon as it finds a convenient location, it goes into the ground to the depth of about six inches, and there builds a sort of nest or abode having a level bottom and an arched ceiling, both being nicely cemented with a secretion emitted by the caterpillar, so that the nest has walls which are impenetrable to other insects and to moisture. After this grave is built it strips off its skin, horns, jaws, and legs, and thus changes into a short, thick chrysalis, having a tolerably hard, black shell. In this state it apparently slumbers throughout the winter, and about the middle of June it opens its shell and softens the cemented ceiling, and then crawls through the ground to the surface. When it reaches the latter, its wings are closely folded to its body and are in a moist, soft state, so that it looks more like a grub than a butterfly. In fifteen or twenty minutes, however, the wings are loosened from close contact with the body, and slowly expand until all the veins are extended. They then become tightly stretched and hardened, and the full imago is then ready to rise and fly in the coming night to investigate the flowers and trees in the woods and fields and to hunt for a genial companion of its own species.



THE REGAL WALNUT MOTH.

LIQUID SHOE POLISH.—Take of gum shellac ½ pound and alcohol 3 quarts. Dissolve, and add camphor 1½ ounces and lamp black 2 ounces.

Beetles that Kill Trees.

The past summer has been one in which the caterpillar and a great variety of bugs and parasites have afflicted both the forest and fruit trees to an unusual extent in this part of the country, and our city parks even have been infested, notwithstanding the utmost vigilance is employed to destroy the pests on their first appearance.

The work of protecting the trees in Central Park from the ravages of insects has been for three years a regular department of the park, in charge of Prof. E. B. Southwick, the entomologist. The N. Y. *Sun*, from which we copy, says that he keeps at work a force of from two to a dozen men, according to the season, and says that encouraging progress is being made in driving out of the park the various insects that have been preying upon vegetation there, and have ruined many fine trees. Scores of infested trees have been cut down and burned, while great care is taken to prevent the insects from getting foothold in the newer growth.

The caterpillars, worms, and such conspicuous pests are dealt with with comparative ease, but the most real damage is done by more insidious insects, such as the bark lice. There are innumerable varieties of these, but in general they are a tiny, almost invisible insect, that pasture upon fresh twigs, and, penetrating the young bark, suck the sap. As they do this an exudation from their bodies builds up over them a hard shell, beneath which they continue to live, and propagate so rapidly that in a short time whole branches are covered with them, the hard shells lying together so thickly and irregularly that they seem the real bark of the tree, which actually is hidden beneath them. Once they are fastened on a limb, these lice cannot move, and to the naked eye show no signs of life, even when they are scraped off with a knife. They quickly kill the branch they are on, however, and eventually the whole tree unless they are removed.

The oyster shell bark louse is a common variety, and curious in that each separate insect, when scraped off, is a tiny gray scale, shaped and ribbed somewhat like an oyster shell. Nearly every sort of tree has a different sort of bark louse to prey upon it. The cochineal insect is one kind of bark louse, but it does not grow in Central Park.

The scale is another insect of many species that infests shrubs and trees in the park. Its appearance and manner of work resembles that of the bark louse.

Plant lice are other pests of vegetation. The manner in which these insects multiply is marvelous. The original eggs are laid by the females in the autumn. They hatch in the spring into wingless forms that in turn produce, not eggs, but living young, which in ten or eleven days produce others, and so on, so that the original female in one summer may be the ancestor of twelve generations, and have one quintillion descendants.

There are also insects that suck the life from the roots of trees, and borers that penetrate their hearts, besides any quantity of things with queer Latin names that in similar ways make life miserable for Professor Southwick and the trees in Central Park.

The usual method of treatment is to remove the insects by a wash and a scraping. Various washes have been tried, but a patent preparation, with, it is said, petroleum as a base, is now the only one used. After the tree has had a good wash with this it is scraped with stiff brushes of bristles, and sometimes of steel, until every trace of the insects is removed. Fine trees receive a precautionary wash frequently during the summer, even when they show no injuries from insect pests.

The fine shade trees at the Fifty-ninth Street and Fifth Avenue entrance to the park are a source of especial trouble. They have received a thorough washing half a dozen times this season, the last one a few days ago.

Through the country at large the extent of the damage done by insect parasites to trees and vegetation is not generally understood. One entomological sharp, who is spoken of as good authority, estimates the annual loss in the United States from this source at $300,000,000. There is no portion of a plant or tree, from the root to the blossom, that has not its own peculiar pests. There are seventy-five different kinds of insects that prey on the apple trees, and nearly as many on the plum, peach, and cherry trees, while the grape vine has to withstand the attacks of fifty insect foes. The same number infest the oak. The elm has twenty, the walnut seventy, while the unfortunate pine has nearly a hundred. These are the figures of Dr. Packard, the standard authority on American insects. Prof. J. A. Lintner, New York State Entomologist, does much better for number. He has listed 176 different species that affect the apple tree alone.

Manuring cannot be Overdone.

The venerable Peter Henderson thinks manuring cannot be overdone, and says: It is a great blunder to attempt to grow vegetable crops without the use of manures of the various kinds. I never yet saw soils of any kind that had borne a crop of vegetables that would produce as good a crop the next season without the use of manure, no matter how rich the soil may be thought to be. An illustration of this came under my observation last season. One of my neighbors, a market gardener of twenty years' experience, and whose grounds have always been a perfect model of productiveness, had it in prospect to run a sixty foot street through his grounds. Thinking his land sufficiently rich to carry through a crop of cabbages without manure, he thought it useless to waste money by using guano on that portion on which the street was to be, but on each side he sowed guano at the rate of 12,000 pounds to the acre, and planted the whole with early cabbages. The effect was the most marked I ever saw. That portion on which the guano had been used sold off readily at $12 per hundred, or about $1,400 per acre, both price and crop being more than the average; but the portion from which the guano had been withheld hardly averaged $3 per hundred. The street occupied fully an acre of ground, so that my friend actually lost over $1,050 in crop by withholding $60 for manure. Another neighbor, with a lease only one year to run, also unwisely concluded it would be foolish to waste manure on his last crop, and so planted and sowed all without. The result was, as his experience should have taught him, a crop of inferior quality in every article grown and loss on his eight acres of probably $2,000 for that season.—*National Stockman.*

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ENGINEERING INVENTIONS.

A car door fastener has been patented by Mr. Eugene F. Hardin, of Lincoln, Neb. It consists essentially of a catch, in connection with which is arranged a sealing attachment and a retaining block, the device being one which can be quickly applied, is cheap and durable, and will prevent any accidental opening of the door.

A car coupling has been patented by Mr. John Harding, Jr., of Wellington, Kansas. The invention consists in the peculiar construction and arrangement of a hinge plate on top of the drawbar, and a weighted drop hinged to or near the front end of the plate and bearing a coupling pin, all combined with the drawbar, the device making an automatic coupling.

A steam trap has been patented by Mr. Samuel Bonser, of Dover, N. H. The head plate has a central aperture, above which a filter is held, and there is a divided cylinder having an annular chamber and an outlet, with tubular spindle, spindle cap, cylindric tube and connecting tube, with other novel features, making a simple device for discharging the water of condensation from steam heating or other steam apparatus.

A device for preventing the explosion of boilers has been patented by Mr. Bendix Meyer, of Gleiwitz, Prussia, Germany. It consists of a plate or cover held on a packing surrounding the outlet steam pipe, a weighted rod or stem holding the cover or plate on the packing, while a stop prevents the plate or cover seating itself on the outlet pipe after the packing is removed or thrown out by the pressure of steam from the boiler.

A gas furnace has been patented by Mr. William W. Waplington, of West Middlesex, Pa. The invention is an improvement on a former patented invention of the same inventor, and provides for using practically all the internal surfaces of the flues for regenerative purposes, with a simple and inexpensive form of gas and air valves, being adapted for both natural and artificial gas, and providing special means for utilizing the heat usually wasted in the ash pit of gas producers.

AGRICULTURAL INVENTION.

A cultivator attachment has been patented by Messrs. Edward Harriss and John N. Tiger, of Waverly, Neb. Combined with graduated and adjustable bars and a suspended shoe are standards carrying adjustable curved knives, making a simple attachment for either a riding or walking cultivator, whereby listed corn, corn in rows, or any vegetable planted in rows, may be expeditiously and effectively worked.

MISCELLANEOUS INVENTIONS.

A combined pencil holder and cigar cutter has been patented by Mr. Paul E. Gonon, of New York City. It consists of a tube with an aperture for the insertion of a pointed cigar end, a cutting tube to slide over the aperture, with spring held therein, and a pencil holder held in the other end of the tube.

A toy blow gun has been patented by Mr. Edward L. Evatt, of La Grangeville, N. Y. The invention covers an improved construction of a gun to be used as a child's toy, or as a blow gun for shooting a dart at a target, by applying the mouth to the rear end of the tube.

An animal power, or tread machine, has been patented by Mr. Eli B. Studebaker, of Fredonia, Kansas. The invention covers novel features of construction and the combination of parts in a machine which may be readily adjusted to accommodate the strength of the animals working it and the desired power and speed of the machinery to be driven.

A process of refining gold and silver has been patented by Messrs. Darley C. Johnson and John P. Ryan, of Brooklyn, N. Y. It consists in placing the alloy of base and precious metals in a cupel, melting the alloy, and covering the surface with pulverized asbestos, with various other features, whereby the cost as well as the waste of refining will be decreased.

An improved bin has been patented by Mr. Holger C. E. Petersen, of New York City. It is designed to be of ornamental appearance, with a compact and substantially dust proof frame, from which the bin may be readily removed and cleaned, and wherein the weight is so distributed that the bin is easily turned upon its axis.

A combined saw jointer, saw set, and gauge has been patented by Mr. John H. Sodee, of Seattle, Washington Ter. It embraces a frame with a guide arm and stationary jaw, in combination with a sliding jaw and cam for operating it, the invention covering various novel parts and details and combinations of the same.

A door attachment has been patented by Mr. William W. Allen, of East Pepperell, Mass. Combined with a latch and an extension thereon is a branch chain connected with the outer end of the extension, a main chain fastened at both ends and held in an angular position by the branch chain, with other novel features, whereby a door can be held locked in open position.

A coat adjuster has been patented by Mr. David H. Purves, of Waddington, N. Y. It is to enable aged, infirm, or sick people to easily put on overcoats or other garments without help, and consists of a garment holder with a vertically movable clamp and lock, with a relatively stationary trip or releasing device to release the lock when the clamp and lock are moved upwardly.

A riding saddle has been patented by Mr. Peter J. Pefley, of Boise City, Idaho Ter. Combined with the tree is a front strap having bifurcated ends, the cantle jockey having reduced ends and lips, with other novel features, whereby one or two girths may be used to accurately fit the saddle, the saddle being adapted to any shape horse and the change being quickly made.

A carpet-stretching machine has been patented by Mr. Leonard Hinkle, of Kenton, Ohio. It has a toothed drawbar, with a head having an opening fitted over the bar, the lower part of the opening having a pawl-like edge to engage the lower teeth of the drawbar, with other novel features, making a stretcher which can be operated by one standing erect, and which will not injure the carpet.

A device for handling cans and bottles has been patented by Mr. David D. Brown, of Brooklyn, N. Y. It consists of a frame of novel construction with spring-held arms, lips for grasping necks of bottles, etc., and other novel features, whereby cans, bottles, and similar goods may be readily and safely removed from shelves above the operator's head and as safely replaced.

A cotton gin rib attachment has been patented by Mr. John E. Keily, of Marshallville, Ga. It is an efficient device for repairing the worn parts of gin ribs, thus saving the expense of new ones, and has a brittle holder underneath the rib, that the saws pass through, which not only extinguishes any fire that may be generated, but cards the cotton and improves the staple.

A nut lock has been patented by Mr. William Adair, of Lecsville, Ohio. By this invention the plate itself is made the locking device, the nuts and the openings in the plate being so made that the latter locks the nuts when they are turned slightly backward on their bolts, the nuts being cut away at their inner corners, and the plates having slots of corresponding form and size.

A waterproofing compound has been patented by Mr. Ferdinand Kreutzer, of New York City. It is for use on leather and fabrics, and intended to render them soft and durable without injury to the material or acting upon the dyes, and consists of raw linseed oil, zinc vitriol, and fat soap, in specified proportions, and combined and cleared after a special described manner.

A bale tie has been patented by Mr. Frederick T. Warburton, of Newport News, Va. Combined with a buckle having a transverse slot with parallel upper and lower sides are band sections having enlarged ends, the slot being wider than the combined thickness of the body of the band and one of its thick ends, but narrower than the combined thickness of both the ends.

An apparatus for wiping metal-coated wire has been patented by Mr. Charles E. Matteson, of Easton, Pa. A circular pipe is held a short distance above a casing through which the wire passes, in combination with inwardly and downwardly projecting pipes, with other novel features, for wiping wire to remove the surplus metal and give it a smooth surface after it leaves the bath.

A thill coupling has been patented by Mr. John W. Yous, of Mound City, Mo. The thill or pole iron has side lugs or trunnions arranged to enter a horizontal recess extending forward from the main vertical recess of the axle clip, the parts being held together by a spring-carrying wedge, thus dispensing with the use of bolts and the ordinary form of rubber anti-rattler.

A neck yoke has been patented by Mr. Fred F. Wheeler, of Ocheyedan, Iowa. It is so made that, should the tugs become detached, the yoke will not be slid off the pole by the forward motion of the horses, while it will revolve free horizontally or laterally upon the pole, yet action in the direction of the longitudinal axis of the pole will be limited by the forward or rearward throw of the yoke.

A process of producing designs upon celluloid has been patented by Mr. Albert Le Roy, of Paris, France. It consists in first printing the design upon any suitable material, then damping and applying upon a celluloid sheet and subjecting both to pressure between hollow steam-heated plates, thus fixing the design permanently upon the celluloid by the simultaneous influence of heat, pressure, and steam.

An automatic fan has been patented by Mr. Charles E. Pierce, of New York City. An oscillating shaft bears a pinion which engages with the segmental gear of an escapement, the motor being either a spring or a weight, and the shaft operating a vibrating arm to which a fan is attached, making a convenient device for driving away flies, cooling rooms, etc.

A clamp has been patented by Mr. Frederick F. Houston, of Chicago, Ill. The clamp head has a thrust block and follower with opposing inclined faces, opposite wedge blocks being fitted between them, with means for drawing one of the wedge blocks toward the other, with a cam lever fitted to the thrust block adapted to bind the latter to a timber, the device being specially adapted for holding work while gluing or otherwise joining the parts.

A cow milker has been patented by Mr. Philip M. Hobbs, of Wymore, Neb. It consists of two hand levers somewhat in the form of a pair of scissors, one of the levers being adapted to be rocked in a vertical plane, one having a teat-receiving recess and the other a projection to fit therein, two of the milkers being used at the same time, one grasped by each hand, and two teats being operated upon by each device.

A saw gummer has been patented by Mr. Lewis J. Grant, of Lamont, Mich. It comprises a die frame with a handle and spring carrying a punch block, combined with a handle having a head with bearings on the under side of the die frame, and an arm secured to the die block and having its lower end connected to a pin secured eccentrically in the head, with other novel features, the device being very handy, and always ready for use.

A grain car door has been patented by Mr. William T. Spillane, of Casselton, Dakota Ter. The door-supporting frame is mounted upon a horizontal way, and a vertically adjustable door is carried by the frame, the parts being so arranged that the door may be raised to rest within the frame, and the frame and door moved to one side to clear the doorway, the device being a substitute for the ordinary detachable grain doors.

A glass beveling machine has been patented by Mr. Thomas F. Gilroy, of New York City. Combined with a grinding wheel having a swinging frame is a revolving shaft mounted therein carrying the glass disk to be beveled, and a screw-threaded spindle eagaging with a gear wheel nut actuated by a hand wheel for raising or lowering the frame, with other novel features, making a simple, durable, and effective machine.

A sash fastener has been patented by Mr. William R. Abrams, of Ellensburg, Washington Ter. The invention covers a novel construction and combination of parts, in connection with a dog journaled in the casing, whereby the edge of the window will be engaged at any point, and effectually prevent the upper sash from being drawn down or the lower sash from being raised, and not interfere with the operation of either sash in an opposite position.

An automatic chuck for all kinds of brass work, such as steam, water, clock, and watch works, has been patented by Mr. Patrick J. Cahill, of Leeds, Mass. It is to take the place of spring chucks, and will grip from the smallest holds up to five tons without friction, being very economical. It has a sliding chuck head operated by hand or treadle, with springs for opening and closing the jaws, and four of them have been working for the past year in the works of the Haydenville Manufacturing Co., Haydenville, Mass.

A dress guard for vehicles has been patented by Mr. Charles L. B. Martin, of Montclair, N. J. It is a folding shield, which may be placed over that portion of the wheel against which a lady's dress is liable to drag in getting in or out of a carriage, and is in the form of two circular troughs, formed of back and side pieces, preferably of leather, united by links, and with a hook which may be adjusted to bear against the rear face of one of the spokes and hold the shield in place. This shield prevents the soiling of the garments on the wheel, and when not in use may be folded and kept beneath the seat.

SCIENTIFIC AMERICAN BUILDING EDITION.

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The *Railroad Gazette*, handsomely illustrated, published weekly, at 73 Broadway, New York. Specimen copies free. Send for catalogue of railroad books.

The Knowles Steam Pump Works, 113 Federal St., Boston, and 93 Liberty St., New York, have just issued a new catalogue, in which are many new and improved forms of Pumping Machinery of the single and duplex, steam and power type. This catalogue will be mailed free of charge on application.

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The Holly Manufacturing Co., of Lockport, N. Y., will send their pamphlet, describing water works machinery, and containing reports of tests, on application.

Durrell's imp. nut tapper. Taps ½ to 2 in. New imp. bolt cutter. Howard Bros., Iron Works, Fredonia, N. Y.

Patent Rights for Sale. Apparatus for building Concrete Buildings and Walls. County rights, $50. State rights, $500. See descriptive notice in SCI. AMERICAN, May 22, 1886. Send for circulars. Ransome, 402 Montgomery St., San Francisco, Cal.

Split Pulleys at low prices, and of same strength and appearance as Whole Pulleys. Yocom & Son's Shafting Works, Drinker St., Philadelphia, Pa.

Send for new and complete catalogue of Scientific Books for sale by Munn & Co., 361 Broadway, N. Y. Free on application.

NEW BOOKS AND PUBLICATIONS.

SCIENTIFIC HORSESHOEING. By William Russell. Cincinnati: Robert Clarke & Co. Pp. xxv., 211.

This book intelligently considers, anatomically and practically, the question of the proper shoeing of horses, and affords a great deal of information which it would be well for all owners of horses to be possessed of. The author has for many years had a high reputation as a successful horseshoer, and in this book points out many of the errors existing where horseshoeing is done by those ignorant of their business or careless in its performance, and the great evils which result therefrom. The book has numerous illustrations explanatory of the structure and functions of the horse's foot, and showing the effects of good and bad shoeing.

WILSON'S QUARTER CENTURY IN PHOTOGRAPHY. By Edward L. Wilson. New York. 1887. Edward L. Wilson. Pp. 528.

In this work we have an admirable body of photographic information. From notes published at various times by some three hundred leading authorities, amateur and professional, a running series of foot notes is composed. Above these, and serving as the basis for their imparted character of commentary, comes the text, rather less in extent than the notes. The whole forms an exceedingly attractive *olla-podrida* of notes and observations. Illustrations of all sorts of devices and assistances in photography are given in liberal profusion. The text is a consecutive and valuable treatise by itself. The notes are made up of selections from the Philadelphia *Photographer*. The author and editor of the work speaks of it as an anniversary publication for himself, he, twenty-five years ago, having entered a photographic establishment as employe. This volume commemorates his devotion of a quarter of a century to his art. From what has been said of the scheme of the book, it is evident that a review is impos-

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sible. To get at the full scope, the book itself should be consulted, and we recommend it to all photographers upon its merits.

POOR'S MANUAL OF RAILROADS, 1887. Twentieth annual number. New York: H. V. & H. W. Poor. Pp. xliii., 1053. $6.

To any one interested to understand the details of the railroad business of the United States, the financial position of the different companies and the various properties, this book is simply invaluable. During the twenty years since the first edition was published, each successive volume has represented a larger and larger mass of more carefully compiled statistics, much being from the sworn statements of railway officials, giving the work a high standing as an authoritative record in a field in which it has no competitors. From the summary statement in the introduction, it appears that there are now employed by all the railroads 26,415 locomotives, 19,252 passenger cars, 6,325 baggage and mail cars, and 845,914 freight cars, and that of a total of 168,047 miles of track, 105,723 miles are now laid with steel rails. The net earnings on all the capital invested is placed at not quite 3½ per cent for the last year.

POOR'S DIRECTORY OF RAILWAY OFFICIALS. New York: H. V. & H. W. Poor. Pp. xliii., 372. $2.

This is properly a supplement to the Manual, bringing within convenient compass the names of all officials desirable to know, for business purposes, to the number of some 30,000, including the names of officers of street and lumber railways as well as steam railways, express and sleeping car companies, and manufacturers of railway supplies.

The *Curio* is the title of a new illustrated magazine, commenced by R. W. Wright, of No. 6 Astor Place, New York. It is in quarto form, handsomely printed, and intended to satisfy the tastes and set forth the possessions of collectors of the rare and curious in the departments of genealogy and biography, heraldry and book plates, coins and autographs, rare books and works of art, old furniture and plate, and other colonial relics. The first number is handsomely embellished with valuable illustrations.

The Machinery of Small Boats for Ships of War, etc., a paper read before the Institution of British Naval Architects, by A. Spyer, presented on application by Fred. M. Wheeler, 95 Liberty Street, N. Y.

Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters, or no attention will be paid thereto. This is for our information, and not for publication.
References to former articles or answers should give date of paper and page or number of question.
Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all, either by letter or in this department, each must take his turn.
Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.
Scientific American Supplements referred to may be had at the office. Price 10 cents each.
Books referred to promptly supplied on receipt of price.
Minerals sent for examination should be distinctly marked or labeled.

(1) A. F. M. desires a recipe for making a good thin shellac varnish. A. Break the gum into small pieces and macerate in a stoppered bottle with ether. After swelling up sufficiently, the excess of ether is poured off, when the shellac will dissolve quite readily in alcohol.

(2) H. S. W. desires a receipt for the cure of warts, one that will remove them permanently. Also please give me the cause of warts. A. Their cause is uncertain; they are said to be caused by uncleanliness. Their removal is easiest effected by means of caustics, such as silver nitrate, nitric acid, or aromatic vinegar.

(3) A. F. S. asks (1) a good receipt for making hektograph ink, both purple, blue, and black. A. Take 1 part aniline of desired color, dissolve in about 7 parts water and add 1 part glycerine. 2. The cause of the glass plates cracking in the Wimshurst electric machine? A. The trouble may be in the clamping—the flanges may not fit, or may not be properly packed. For electrical supplies, address any of the makers of or dealers in such goods advertising in our columns.

(4) G. F. D. writes: I have been troubled of late with what is generally termed sour stomach, and have been taking a third of a teaspoon of saleratus or thereabout, to overcome the acidity. Is that a proper corrective? A. You had better take a cup of clear warm water an hour before meals, and occasionally a bottle of citrate of magnesia to clear the stomach, with good habits and plenty of exercise. See most interesting lectures on dyspepsia, its treatment and cure, in SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 323, 129, 215.

(5) H. G. asks a recipe for a good paint or stain for patterns for castings. A. Shellac varnish alone or with lampblack or vermilion is in ordinary use for varnishing patterns. Methylic or wood alcohol is the best solvent of shellac for making the varnish. Shellac varnish may also be purchased through the paint trade.

(6) J. McD. asks: 1. Is there really a fourth state of matter, known as radiant matter? A. The question is yet undecided. It is safest to conclude that there is probably no fourth state of matter. 2. Does all ice maintain a fixed temperature or degree of cold? In other words, would ice frozen at or near north pole and brought to North Carolina be of same temperature as ice formed in North Carolina? A. Ice can be of all degrees of temperature below 32° Fah. The fixed point of temperatnre is its melting point. This is always 32° Fah.

(7) P. H., Jr., asks: 1. Will a siphon draw water through 2,400 feet of 1¼ inch pipe with a rise of 20 feet and a fall of 80 feet? A. Yes; but it requires care in filling or charging, to free every part from air, and an air chamber at the apex to prevent a break in the flow by accumulation of air which is liberated by the partial vacuum. Lower end should be immersed or turned up to prevent air drawing into the end, if the slope is steep. 2. A receipt for roof paint for corrugated iron roofing. A. Use pulverized oxides of iron, as yellow and red iron ochers, or brown hematite iron ores finely ground, and simply mixed with linseed oil and a drier.

(8) F. H. S. asks: What is the best battery for running a small electric turntable for show windows? How is the battery made? I have a plunge battery of ten cells carbon and zinc plates in electropoion fluid. Would this be suitable to run the above or a small electric lamp, or would it soon run out? A. For the above purposes a Bunsen battery is perhaps the best. For description of this and other forms, see our SUPPLEMENT, Nos. 157, 158, and 159. The plunge battery, however, is very serviceable.

(9) G. A. M.—Rule for surface of oblate spheroid: Square their diameters, and multiply square root of half their sum by 3·1416 and this product by the transverse diameter, or

$$\sqrt{\frac{d^2 + d'^2}{2}} \times 3{\cdot}1416 \times d'.$$

For prolate spheroid: As above by inserting conjugate diameter in place of transverse. The other formulæ asked for involve conditions in mathematical astronomy too complicated for this column.

(10) J. W. D. L.—The expenditures of the German government last year, including cost of army and navy and ordinary expenses of the empire, were $174,153,877. The general cost of the United States governmeut was $242,483,138. Any such comparison, however, would be greatly misleading without counting the expenses of the several States, which in Germany have to support their army contingents, which is not the case here. Prussia, for instance, has a total expenditure of $324,868,000, Bavaria $60,000,000, Baden $41,000,000, etc. Our State governments are expensive, but paying for a large special army contingent each does not figure in such expense.

(11) P. L. asks: What is the proper composition of the metal in a safety plug for a boiler, and at what temperature does it melt? A. We have no record of the composition used by various parties advertising the sale of fusible plugs. The following alloys, with their corresponding melting points, together with the temperature of steam at various pressures, may be found useful:

					Steam pressure by gauge.	Temp.
Tin 6	Lead 1			381° F.		
" 5	" 1			378° "		
" 4	" 1			365° "	120 lb.	350° F.
" 3	" 1			356° "	105 lb.	341° "
" 2	" 1			340° "	90 lb.	331° "
" 1½	" 1			334° "	75 lb.	320° "
" 4	" 4	Bismuth	1	320° "	60 lb.	307° "
" 3	" 3	"	1	310° "	45 lb.	282° "
" 2	" 2	"	1	292° "	30 lb.	274° "
" 1	" 1	"	1	254° "	15 lb.	250° "

So much depends, however, on the way in which an alloy is made, the purity of its original metals, and the changing conditions to which a fusible plug is subjected, that it is very doubtful whether they should ever be depended upon in critical places.

(12) Jones asks how to use glucose in making pop corn balls. A. We know of nothing better for making pop corn balls than molasses boiled until stringy and then rolling the corn in it. Glucose is decidedly inferior.

(13) G. S. asks the best way to mix lime whitewash for outside work. A. Take a clean, water-tight barrel and put into it ½ bushel lime. Slake it by pouring boiling water over it and in sufficient quantity to cover it 5 inches deep, stirring it briskly till thoroughly slaked. When slaking has been effected, dissolve in water and add 2 pounds sulphate of zinc and one of common salt.

(14) W. L. F.—There are several receipts for making the black color on brass: 1. 5 drachms nitrate of iron, 1 pint water. 2. 5 drachms perchloride of iron, 1 pint of water. 3. A solution of chloride of platinum in water.

(15) R. K. B.—The curvature of the earth is such that a straight line a mile in length would be 2·04 inches from the surface at either end. If the line were two miles long, either end would be 8·004 inches from the surface. The measures are found by determining the tangent of the circle of the earth's radius.

(16) J. E. N.—The cultivation of the tree that yields annotto would not prove profitable, as the demand for the product is too limited. It is used chiefly for coloring butter and cheese. Messrs. W. H. Schieffelin & Co., 170 William Street, New York, and all other large drug houses import it in quantities such as to suit the demands of their trade.—The address of our Consul-General in Brazil is H. C. Armstrong, Rio de Janeiro.

(17) J. S. asks if there is any simple and reliable method of testing a 12 horse power boiler at 100 pounds water pressure. The said boiler is situated in a part of India where no government test is procurable, and it cannot be sent to any boiler works. What apparatus is necessary for the purpose? A. We know of no safe way of testing the boiler except by improvising a pump, no matter how small. A common plumber's force pump is sufficient. Fill the boiler full of water by any convenient means, through the safety valve or otherwise. Use the pressure gauge attached to the boiler, if you think it is correct. Also set the safety valve weight at 100 pounds by its mark. Then pump water in by any means at hand. It takes but very little water to run the gauge up to 100 pounds after the boiler has been filled. If you have a steam pump attached to the boiler, a lever may be arranged to work the pump a few strokes for the required pressure. The engine in the absence of all pumping appliances may be made to put pressure upon the boiler by pulling it backward and pouring water into the exhaust, but this should be managed cautiously. With proper precautions the following method may be used. Fill the boiler with water, leaving absolutely no air space. It must be solid water. Then by slowly firing, the pressure can be run up to any desired amount. The instant the pressure is reached, or an instant before, draw the fire. This should only be done by an experienced engineer.

(18) A. M. H. asks directions for making paint to paint pipes and radiators for steam heating. A. A little clear japan varnish mixed with ordinray colors makes a very good cheap paint for radiators. The regular japan varnishes in colors are used for fine work. This requires to be baked in an oven at 250°, and makes a permanent color. Sometimes ordinary colors in oil are used. When dry, varnish with copal.

(19) B. F. B.—Hard solder is generally made of brass of a lower grade than the work to be brazed. For brazing the ordinary commercial brass, use the same kind of brass, melting in a crucible and adding 20 per cent of zinc. For brazing iron, use copper or ordinary brass. Flux with borax.

(20) P. A. asks: Which is the best—a piston or a rotary fire engine? A. Both are manufacturned and in use. The piston engine and pump are preferred by the New York fire department.

(21) J. H. L.—Fulminate of gold explodes by slight increase in heat caused by compression, but is exceedingly uncertain and dangerous. Fulminate of platinum is next safer and explodes at a temperature of 400° Fah. Both the above are very violent, and explode with the slightest blow. Pure fulminate of mercury is very quickly and easily exploded. It is mixed with potassium nitrate or chlorate to moderate its violence, when used for charging gun caps.

(22) J. M. C. writes: In "Haswell," issue of 1884, on page 480, he says, the evaporative power of one pound of anthracite coal is 7·05 to 9·05 pounds of fresh water. Through how many degrees is this water supposed to be raised? A. The note referred to in "Haswell" is only an average or generalization of evaporative effect from mean temperature or 60°. The ultimate evaporative effect of the best coal, less the ash, is 14·9 pounds from water at temperature of 212° without pressure. When tests are made under pressure, the evaporative effect is reduced to and from 212° temperature without pressure. Thus the best forms of boilers doing low duty may run up to 12 pounds per pound of coal, and even higher than this is claimed with regenerative furnaces. The quality of coal varies greatly, as well as the condition of boilers. You will also find in "Haswell" interesting tables of the effective value of different kinds of coal. A large percentage of boilers in use are evaporating 5 pounds and under per pound of coal. Incrustation, dirty flues or tubes and overwork are the main features of small boiler duty.

(23) R. B. says: I am going to build a small steam engine 3 inches bore and 5 inches stroke, what is the rule in plain figures to get at the power? A. For small engines of uncertain cut off multiply the area of the cylinder by four-fifths the steam pressure and this product by the travel of the piston in feet per minute. Divide last product by 33,000 for the horse power. 2. What size boiler shall I need to get one-half horse power from this engine? A. Your boiler should contain for a half horse power 8 square feet of surface exposed to the fire. 3. What size boiler should I need to rnn it at its fullest capacity? A. Your engine is equal to 4 horse power at 200 revolutions per minute and 100 pounds steam pressure. For this you will need a 5 horse power boiler or one containing 70 square feet of fire surface. 4. What is the rule to get at the power of inclosed water wheels or turbine? A. Turbines give from 75 to 80 per cent of the value of the water flow. The value of the water flow is the volume falling 1 foot per minute multiplied by the weight of a cubic foot. For the horse power, divide the above product by 33,000.

(24) M. asks the best method of gluing emery on wheels and belts. A. Use the best emery and good tough glue made thick. Brush the glue on rather thick and follow the brush at once with the emery from the hand or a small piece of wire cloth soldered to the edge of a small shovel, so as to distribute the emery readily. Use the flat hand to press the emery close. A small flat piece of wood may also be used to advantage.

(25) A. L. G. asks: 1. What is the best for polishing bright iron work, such as cylinder heads and guides? A. Polish bright iron work with rottenstone and oil, if it is running machinery. Work not liable to have its running parts injured by emery, may be polished with emery cloth or flour emery and oil, as it is a quick way. You may polish the cylinder head with emery, but not the slides of an engine. Tripoli and oil makes a high finish after the emery. 2. What is best for polishing Russia iron? A. Russia iron should only be wiped clean with oil. The black surface will come off if polished with abrading material.

MINERALS, ETC.—Specimens have been received from the following correspondents, and have been examined with results stated.

A. D. G.—The material sent is sand containing iron ore, and is of value only if in sufficient quantity and purity to smelt economically, which is very seldom the case.

TO INVENTORS.

An experience of forty years, and the preparation of more than one hundred thousand applications for patents at home and abroad, enable us to understand the laws and practice on both continents, and to possess unequaled facilities for procuring patents everywhere. A synopsis of the patent laws of the United States and all foreign countries may be had on application, and persons contemplating the securing of patents, either at home or abroad, are invited to write to this office for prices, which are low, in accordance with the times and our extensive facilities for conducting the business. Address MUNN & CO...office SCIENTIFIC AMERICAN, 361 Broadway, New York.

INDEX OF INVENTIONS

For which Letters Patent of the United States were Granted

September 27, 1887,

AND EACH BEARING THAT DATE.

[See note at end of list about copies of these patents.]

Adding machine, S. E. Austin 370,719
Adjustable wrench, C. M. Brown 370,447
Agrng and purifying liquors, device for, Lochner & Oester 370,549
Air compressing apparatus, L. S. Chichester 370,376
Air purifier and evaporator, J. W. Collins 370,529
Alarm. See Burglar alarm.
Alarm lock. Bradsby & Hagee 370,677
Alarm lock, U. V. Jaeggi 370,480
Animal power, E. B. Studebaker 370,569
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Area, floor, roof, and sidewalk construction, P. H. Jackson 370,625
Ax, J. Ballard 370,596
Axle box, car, G. M. Brill 370,722
Axle box, car, J. W. Cloud 370,449
Bag. See Tobacco bag.
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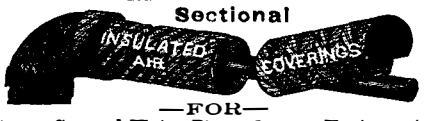

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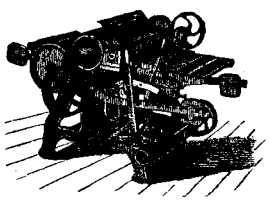

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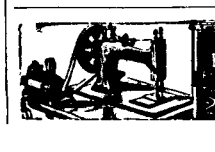

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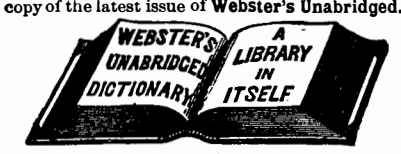

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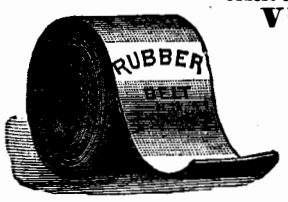

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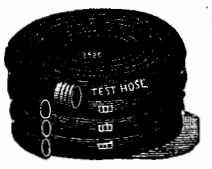

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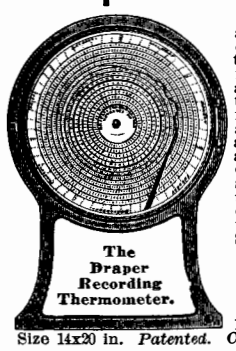

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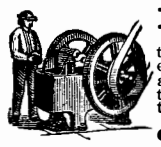

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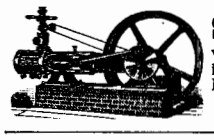

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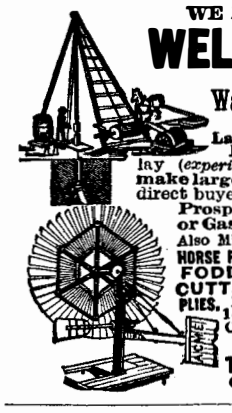

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